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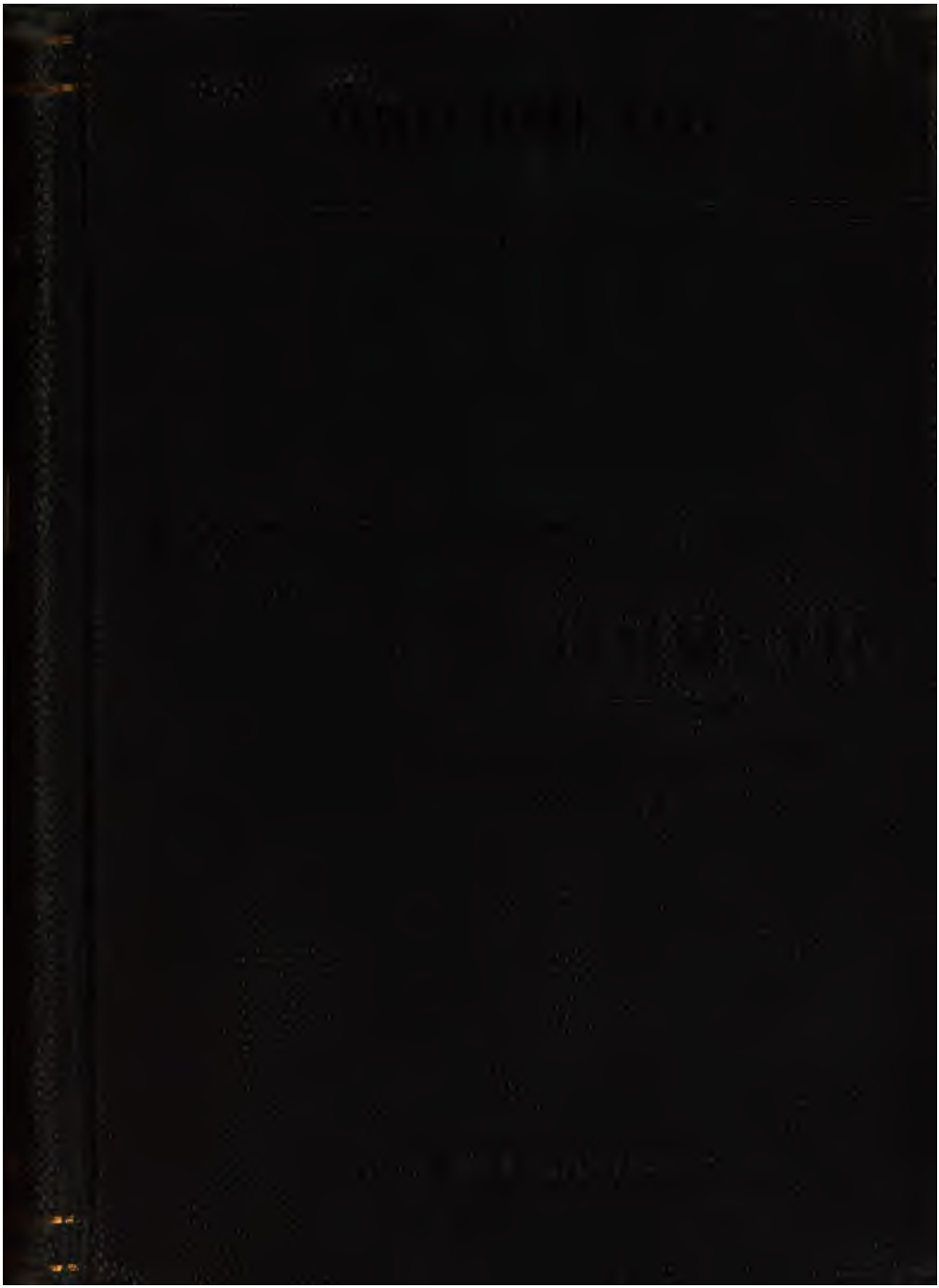

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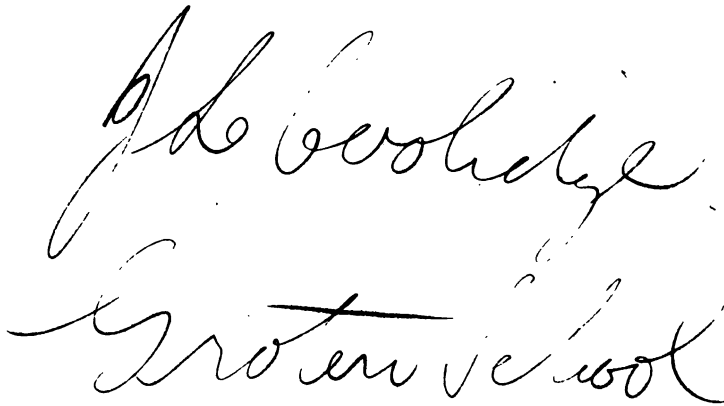

EXERCISES IN ARITHMETIC

BY

G. A. WENTWORTH

AND

G. A. HILL

PART I.: EXERCISE MANUAL

PART II.: EXAMINATION MANUAL

BOSTON, U.S.A., AND LONDON

PUBLISHED BY GINN & COMPANY

1897

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EXERCISE MANUALS

No. I.

ARITHMETIC

BOSTON, U.S.A., AND LONDON
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ARITHMETICAL EXERCISES.

CHAPTER I.

INTEGRAL NUMBERS.

Add:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
51	56	48	36	25	17	18	57	15	44	19	91
46	63	31	42	52	82	24	31	8	21	27	42
30	72	45	50	49	25	91	28	23	36	48	36
25	81	82	81	38	13	33	63	70	8	39	82
32	17	19	14	41	80	64	90	61	14	7	71
47	26	21	35	57	45	75	9	55	27	9	54

13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
48	52	8	16	33	54	55	68	23	13	48	35
9	61	43	48	52	46	67	5	9	99	6	42
17	26	52	85	27	8	78	43	25	7	51	57
29	28	67	7	38	19	9	67	68	85	9	64
83	83	9	26	41	92	4	25	79	64	23	49
75	94	17	35	9	57	18	14	7	39	88	87

25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.
51	46	30	25	32	47	18	24	91	33	64	75
56	63	72	81	17	26	57	31	28	63	90	9
48	31	45	82	19	21	15	8	23	70	61	55
36	42	50	81	14	35	44	21	36	8	14	27
25	52	49	38	41	57	19	27	48	39	7	9
17	82	25	18	80	45	91	42	36	82	71	54

Add:

37.	38.	39.	40.	41.	42.	43.	44.	45.	46.
123	516	321	225	871	213	421	222	624	448
205	341	75	716	215	327	87	85	231	526
310	236	184	348	64	98	116	376	785	379
79	110	769	519	371	716	615	584	923	87
118	196	815	96	296	825	379	972	84	999

47.	48.	49.	50.	51.	52.	53.	54.
1234	4321	2345	2783	5207	3426	2358	9210
368	6450	3456	345	3584	783	7291	1029
5721	378	4567	1497	2671	5279	5946	291
1050	4291	5678	5840	987	1085	7368	3587
4862	5782	689	9010	3512	9270	5492	2785
9215	6431	7890	2709	6705	876	876	8899

55.	56.	57.	58.	59.
12345	23456	123456	580921	584321
3276	72564	258071	42364	92047
4721	3785	589347	527913	3681
371	23584	258923	80235	927
51028	987	720145	726048	1078
61234	96	396012	4386	92569

60.	61.	62.	63.	64.
5203461	2587609	1357924	8274108	5791350
9350472	3582764	6804281	3509270	246801
1456849	1357908	5975325	4680259	1384650
2604030	4670253	7101584	3584672	2794589
5876543	8492056	9276432	9876543	6532108
1234567	4759841	6789009	5279614	7999888

65. $123 + 516 + 321 + 225 + 871 + 213 + 421 + 85 + 231.$

66. $205 + 341 + 75 + 716 + 215 + 327 + 87 + 222 + 624.$

67. $310 + 236 + 184 + 348 + 64 + 98 + 116 + 376 + 785.$

68. $79 + 110 + 769 + 519 + 371 + 716 + 615 + 584.$

69. $118 + 196 + 815 + 96 + 296 + 825 + 379 + 972 + 84$

70. $1234 + 4321 + 2345 + 345 + 5207 + 3426 + 2358.$

71. $368 + 6450 + 3456 + 2783 + 3584 + 783 + 7291.$

72. $5721 + 378 + 4567 + 1497 + 2671 + 5279 + 5946.$

73. $1050 + 4291 + 5678 + 5840 + 987 + 1085 + 7368.$

74. $4862 + 5782 + 689 + 9010 + 3512 + 9270 + 5492.$

75. $9215 + 6431 + 7890 + 2709 + 6705 + 876 + 876.$

76. $12345 + 23456 + 5 + 92583 + 23504 + 358 + 56789.$

77. $3276 + 72564 + 23 + 4620 + 4368 + 9246 + 3587.$

78. $4721 + 3785 + 936 + 973 + 25 + 14376 + 296.$

79. $371 + 23584 + 6543 + 25 + 9 + 845 + 89.$

80. $51028 + 987 + 92840 + 9 + 36 + 29 + 7.$

81. $61234 + 96 + 72104 + 17 + 378 + 7 + 12345.$

82. $123456 + 580921 + 654321 + 5 + 345 + 584321.$

83. $258071 + 42364 + 41058 + 24 + 6197 + 92047.$

84. $589347 + 527913 + 3792 + 358 + 52718 + 3681.$

85. $258923 + 80235 + 589 + 1497 + 6904 + 927.$

86. $720145 + 726048 + 75 + 36725 + 871 + 1078.$

87. $396012 + 4386 + 9 + 187348 + 89 + 92569.$

88. $5203461 + 2587609 + 1357924 + 8274108 + 5791350$

89. $9350472 + 3582764 + 6804281 + 3509270 + 246801$

Find from the table below the area and population in 1880 of:

90. The North Atlantic States. Nos. 1–9.

91. The South Atlantic States and District of Columbia. Nos. 10–18.

92. The Northern Central States. Nos. 19–29.

93. The Southern Central States. Nos. 30–36.

94. The Western States and Territories. Nos. 37–47.

95. The whole United States and Territories.

No.	Name.	Area in Sq. miles.	Population.	No.	Name.	Area in Sq. miles.	Population.
1.	Maine.	29,895	648,936	25.	Iowa.	55,475	1,624,615
2.	N.H.	9,005	346,991	26.	Mo.	68,735	2,168,380
3.	Vt.	9,135	332,286	27.	Dak.	147,700	135,177
4.	Mass.	8,040	1,783,085	28.	Neb.	76,185	452,402
5.	R.I.	1,085	276,531	29.	Kan.	81,700	996,096
6.	Conn.	4,845	622,700	30.	Ky.	40,000	1,648,690
7.	N.Y.	47,620	5,082,871	31.	Tenn.	41,750	1,542,359
8.	N.J.	7,455	1,131,116	32.	Ala.	51,540	1,202,505
9.	Penn.	44,985	4,282,891	33.	Miss.	46,340	1,131,597
10.	Del.	1,960	146,608	34.	La.	45,420	939,946
11.	Md.	9,860	934,943	35.	Tex.	262,290	1,591,749
12.	D.C.	60	177,624	36.	Ark.	53,045	802,525
13.	Va.	40,125	1,512,565	37.	Cal.	155,980	864,694
14.	W.Va.	24,645	618,457	38.	Col.	103,645	194,327
15.	N.C.	48,580	1,399,750	39.	Nev.	109,740	62,266
16.	S.C.	30,170	995,577	40.	Ore.	94,560	174,768
17.	Ga.	58,980	1,542,180	41.	Wash.	66,880	75,116
18.	Fla.	54,240	269,493	42.	Idaho.	84,290	32,610
19.	Ohio.	40,760	3,198,062	43.	Mon.	145,310	39,159
20.	Ind.	35,910	1,978,301	44.	Wy.	97,575	20,789
21.	Ill.	56,000	3,077,871	45.	Utah.	82,190	143,963
22.	Mich.	57,430	1,636,937	46.	Ari.	112,920	40,440
23.	Wis.	54,450	1,315,497	47.	N.M.	122,460	119,565
24.	Minn.	79,205	780,773				

96. A laborer threshed 44 bu. of wheat, 114 bu. of rye, and 167 bu. of oats. How many bushels did he thresh in all?

97. A man bought a horse for $475, a carriage for $175, a harness for $78, and a whip for $2. What did he pay for them all?

98. In 1880 the population of New York City was 1,206,299, and that of Brooklyn was 566,663. What was the population of both cities together?

99. The Duke of Wellington's army at Waterloo consisted of the following British troops: infantry, 20,661; cavalry, 8735; artillery, 6877. There were also 33,413 Belgian and other allies. How many British troops were there in all? What was the whole strength of his army?

100. The army of Napoleon at Waterloo consisted of 48,950 infantry, 15,765 cavalry, 7732 artillery. What was the whole number?

101. A bank had $38,463 in gold, $37,986 in bills, and $58,896 in cash items. Find the whole amount.

102. A horse-jockey bought a horse for $527, and a colt for $189. He sold them, gaining $25 on the horse and $49 on the colt. What did he receive for each animal? What did he receive for both together?

103. Charles counts the kernels on 4 ears of corn. He finds on the first 460, on the second 454, on the third 486, and on the fourth 354. What was the total number?

104. Rollins & Morse put 4 loads of coal in my cellar. The first weighed 2472 lbs., the second 2624 lbs., the third 2831 lbs., and the fourth 3046 lbs. What was the total weight?

105. What were the total expenses of Mr. Jones for one year, the items being as follows: rent, $192; groceries, $298; meat, $100; fish, $30; milk, $30; fuel, $40; clothing, $150; boots and shoes, $28; dry goods, $15; education of children, $22; taxes, $2; sundries, $29.

106. One factory employs 96 males and 64 females; another, 126 males and 54 females; and a third, 102 males and 68 females. Find the number of persons employed by each factory; the whole number of males; the whole number of females; and the whole number employed.

	Males.	*Females.*	*Total.*
First factory,	96	64	
Second factory,	126	54	
Third factory,	102	68	

107. The egg product of a farm for one month was:

Week.	*Hens' Eggs.*	*Ducks' Eggs.*	*Goose Eggs*
First,	164	127	15
Second,	181	135	25
Third,	171	145	18
Fourth,	157	139	17

Find (1) the number of eggs laid each week; (2) the total number laid; (3) the total number of each kind laid.

108. A stable-keeper's monthly consumption of oats for his horses was as follows:

January,	1116 bushels.	July,	810 bushels.
February,	1008 "	August,	837 "
March,	1116 "	September,	1170 "
April,	1080 "	October,	1197 "
May,	1302 "	November,	1116 "
June,	1267 "	December,	1177 "

Find the amount for each quarter and for the year?

109. The distances between the chief cities on the Boston and Albany Line to New York, and the times of traversing them by the fast express, are as follows:

	Miles.	*Minutes*
Boston to Worcester,	44	78
Worcester to Springfield,	54	96
Springfield to Hartford,	26	46
Hartford to New Haven,	36	70
New Haven to Stamford,	39	72
Stamford to New York,	37	58

Find (1) distance from Boston to each of the other cities; (2) the distance from New York to each of the other cities; (3) the time required for the express to travel from Springfield to each of the other cities.

110. A cattle-dealer has sold 17 oxen, 64 sheep, and 7 lambs; he has left 228 oxen, 475 sheep, and 49 lambs. How many animals of each kind did he have, and how many all together?

111. How many quarts of milk did Mr. Hall's cows yield during April, the daily score being as follows:

102	98	104	104	98
98	96	103	105	105
76	96	102	104	103
103	98	104	98	97
102	99	99	102	165
98	101	103	96	118

112. George has $5.98; Ellen has 69 cents more than George, but 23 cents less than Mary. How much money has Mary? How much have they together?

113. A butcher sold one year:

72	ox-hides,	weighing	4684	lbs., for	$328
36	cow-hides	"	1720	" "	104
185	calf-hides	"	2432	" "	265
Total,	hides,	weighing		for	

114. A baker sold one week:

484	large loaves,	weighing	942	lbs., for	$38.72
424	small loaves,	"	404	" "	16.16
146	graham loaves	"	285	" "	11.68
Total,	loaves,	weighing		lbs., for	

115. The wine made one season from the vintage of four vineyards, in quantity, kind, and value, was as follows:

Vineyard.	*Red Wine.*	*Value.*	*White Wine.*	*Value.*
First,	3049 gals.	$2317	2784 gals.	$1927
Second,	5419 "	3912	2095 "	1142
Third,	17148 "	9874	12904 "	6725
Fourth,	10838 "	8117	4191 "	3084
Total,				

116. A butcher slaughtered one month 4 oxen. They furnished:

	Meat.	*Hide and Tallow.*	*Refuse.*	*Total.*
The first,	624 lbs.	164 lbs.	454 lbs.	
The second,	538 "	154 "	412 "	
The third,	510 "	150 "	384 "	
The fourth,	658 "	186 "	498 "	
Total,				

Subtract:

	I.	II.	III.	IV.	V.
117.	378	5830	12345	305070	5678023
	69	2919	1258	123549	1584318
118.	976	2345	50607	280491	7654321
	583	1438	38594	173258	6372918
119.	476	3456	30927	472085	3587025
	287	2584	27918	214376	1694916
120.	800	8005	23504	601407	4102030
	177	6324	12765	342158	1460928
121.	900	2004	42060	432000	5004006
	577	1883	31846	120468	2361238
122.	801	4013	35620	470062	1007008
	375	2508	16285	358404	925379
123.	404	5030	80000	935026	5000003
	168	1569	36452	476387	2409768
124.	506	6000	60305	502801	3000000
	177	2318	48578	315847	2756859
125.	605	8004	70004	836425	4001001
	246	3546	28596	478596	3579246
126.	801	8364	41035	987054	3050702
	628	2575	18647	278765	2949684

127. 33333 — 24444.
128. 11111 — 9999.
129. 52431 — 38657.
130. 63574 — 29885.
131. 73650 — 45796.
132. 94306 — 28579.
133. 83104 — 57685.
134. 50402 — 38765.
135. 71002 — 46854.
136. 80042 — 36758.
137. 90132 — 64574.
138. 61213 — 47658.
139. 81427 — 48569.
140. 802041 — 358476.
141. 710032 — 562849.
142. 623004 — 246897.
143. 534702 — 185943.
144. 420573 — 236784.
145. 625000 - 436128.
146. 730004 - 347586.
147. 800052 - 563479.
148. 900006 — 741568.
149. 800000 — 243685.
150. 714320 — 185196.
151. 904062 — 385794.
152. 603004 — 485967.
153. 521347 — 185698.
154. 400100 — 138562.
155. 824153 — 367594.
156. 702106 — 268459.
157. 645312 — 287465.
158. 510340 — 386572.
159. 423156 — 185978.
160. 48005 — 34567.
161. 90600 — 28753.
162. 80050 — 27684.
163. 50210 — 18765.
164. 60032 — 48965.
165. 73145 — 27698.
166. 82006 — 37698.
167. 92134 — 28659.
168. 60030 — 15744.
169. 50000 — 27348.
170. 724350 — 386584.
171. 531602 — 473856.
172. 853047 — 256839.
173. 940521 — 563768.
174. 703642 — 426879.
175. 621300 — 384653.
176. 832005 — 465837.
177. 960043 — 378695.
178. 700321 — 465872.
179. 634000 — 287653.
180. 790005 — 294785.
181. 800021 — 385692.
182. 510203 — 286754.
183. 612345 — 347598.
184. 700400 — 285647.

Earnings of Boston Railroads. From the statistics given below, find the increase in gross earnings of each road for 1883 over 1882, and the net earnings for 1883.

	Name.	*Gross Earnings,* 1882.	*Gross Earnings,* 1883.	*Gross Expenses,* 1883.
185.	Eastern,	$3,403,078	$3,584,506	$2,310,830
186.	Boston & Maine,	2,768,326	2,915,943	2,070,760
187.	Boston & Lowell,	2,083,241	2,127,305	1,512,134
188.	Fitchburg,	2,418,431	2,825,024	2,187,941
189.	Boston & Albany,	7,348,276	8,103,947	6,158,904
190.	Boston & Prov.,	1,564,310	1,646,962	1,311,822
191.	Old Colony,	4,126,258	4,249,179	3,020,738
192.	N. Y. & N. E.,	3,302,789	3,568,953	3,163,525

Population of the largest cities in the United States. Find for each city the increase for each decade, and for both decades.

	Name.	*In* 1860.	*In* 1870.	*In* 1880.
193.	Boston,	177,812	250,526	369,832
194.	New York,	805,651	942,292	1,206,299
195.	Brooklyn,	266,661	396,099	566,663
196.	Philadelphia,	562,529	674,022	847,170
197.	Baltimore,	212,418	267,354	332,313
198.	Washington,	61,122	109,199	147,293
199.	Cincinnati,	161,044	216,239	255,139
200.	Chicago,	109,260	298,297	503,185
201.	St. Louis,	160,773	310,864	350,518
202.	New Orleans,	168,675	191,418	216,090
203.	San Francisco,	56,802	149,473	233,859

Consumption of sugar in the United States. Find for each year: (1) the total consumption; (2) the increase over the preceding year; (3) the excess of imported over domestic sugar consumed.

	Year.	*Imported sugar.*	*Domestic sugar.*
204.	1878,	614,170 tons.	71,500 tons.
205.	1879,	631,174 "	112,000 "
206.	1880,	730,519 "	88,822 "
207.	1881,	790,978 "	127,367 "
208.	1882,	866,517 "	76,373 "

		Tons hay.	*Bu. corn.*	*Bu. oats.*
209.	A farmer harvested	27	256	189
	His stock consumed	19	197	92
	There remain			

		Bu. corn.	*Bu. rye.*	*Bu. oats.*
210.	A farmer raised in 1883,	487	133	274
	in 1884,	461	97	185
	Difference			

		Cds. oak.	*Cds. maple.*	*Cds. pine.*
211.	A wood-dealer has for sale	275	318	462
	He sells	128	77	219
	There remain			

212. A butcher had in his shop Monday evening,

	Lbs. beef.	*Lbs. mutton.*	*Lbs. veal*
	1245	624	292
Tuesday he sells	426	204	114
He has left			
Wednesday he sells	231	218	73
He has left			
Thursday he sells	267	24	45
He has left			

213. There are 96 scholars in a certain school; 49 of them are boys. How many are girls?

214. A man owes $1217. If he pays $978, how much will he still owe?

215. In 1880, the population of Boston was 369,832, and that of Baltimore, 332,313. What was the difference?

216. The Æneid has 9892 lines, and the Iliad 15,683. How many more lines has the Iliad than the Æneid?

217. The polar diameter of the earth is 41,707,620 feet, and the equatorial diameter is 41,847,426 feet. What is the difference?

218. The art of printing was discovered about the year 1449. How long is it from that date to the year 1884?

219. What number must be added to 238,541 to make a million?

220. By how much does the sum of 2853 and 4509 exceed the difference between 9241 and 1888?

221. A tank holding 250 gallons of water was filled by pouring 57 gallons into it. How many gallons of water were already in the tank?

222. Shakespeare was born in 1564 and died in 1616; Milton was born in 1608 and died in 1674. How many years more did Milton live than Shakespeare?

223. Mrs. Lincoln bought a sofa for $96, a rug for $19, an easy-chair for $67, and a mirror for $16. She gave to the salesman $200. How much should he give her back?

224. A farmer requires for his own use during the winter 22 tons of hay, 165 bushels of corn, and 110 bushels of oats. He has raised 35 tons of hay, 288 bushels of corn, and 191 bushels of oats. How much of each can he sell?

Find the products of:

225. 407 × 8736.
226. 205 × 8347.
227. 306 × 9287.
228. 306 × 9674.
229. 508 × 7536.
230. 407 × 7659.
231. 604 × 6429.
232. 504 × 5938.
233. 705 × 5319.
234. 608 × 8437.
235. 803 × 4928.
236. 705 × 9183.
237. 907 × 3719.
238. 809 × 7536.
239. 507 × 6825.
240. 906 × 6392.
241. 506 × 8765.
242. 605 × 8746.
243. 409 × 7654.
244. 308 × 9475.
245. 708 × 4567.
246. 406 × 7982.
247. 605 × 3859.
248. 507 × 6987.
249. 574 × 1357.
250. 329 × 1987.
251. 506 × 7071.
252. 476 × 2958.
253. 230 × 6487.
254. 203 × 6487.
255. 3057 × 29,486.
256. 7026 × 68,473.
257. 5096 × 86,573.
258. 5038 × 85,237.
259. 6018 × 56,039.
260. 4057 × 73,946.
261. 4069 × 62,508.
262. 6095 × 45,293.
263. 8035 × 42,706.
264. 8046 × 27,358.
265. 5028 × 50,728.
266. 2068 × 65,317.
267. 6043 × 53,163.
268. 4059 × 82,537.
269. 7028 × 65,014.
270. 3082 × 47,349.
271. 5067 × 72,369.
272. 5073 × 71,386.
273. 4075 × 36,425.
274. 6072 × 46,382.
275. 8032 × 28,743.
276. 5067 × 52,389.
277. 9054 × 87,536.
278. 8024 × 79,531.
279. 4368 × 98,476.
280. 7896 × 98,476.

281. 48,637 × 50,206.
282. 30,604 × 23,579.
283. 50,604 × 60,208.
284. 23,456 × 60,403.
285. 29,046 × 70,809.
286. 34,567 × 50,403.
287. 20,704 × 30,807.
288. 40,503 × 45,678.
289. 35,279 × 60,403.
290. 30,504 × 56,789.
291. 43,568 × 50,608.
292. 67,895 × 70,503.
293. 40,706 × 54,632.
294. 50,703 × 78,956.
295. 69,425 × 80,504.
296. 30,705 × 89,567.
297. 50,790 × 57,009.
298. 25,417 × 76,532.
299. 27,938 × 36,845.
300. 37,625 × 83,246.
301. 38,564 × 52,736.
302. 41,769 × 58,463.
303. 25,748 × 83,469.
304. 56,123 × 81,753.
305. 47,539 × 84,317.
306. 36,729 × 69,487.
307. 54,973 × 72,436.
308. 23,895 × 25,637.
309. 64,952 × 83,769.
310. 75,968 × 98,765.
311. 35,279 × 54,628.
312. 26,513 × 47,824.
313. 49,382 × 62,835.
314. 39,627 × 72,693.
315. 49,387 × 56,428.
316. 52,764 × 81,635.
317. 36,947 × 74,836.
318. 15,629 × 24,813.
319. 47,395 × 82,519.
320. 67,215 × 92,308.
321. 58,368 × 75,479.
322. 27,050 × 90,070.
323. 14,896 × 80,090.
324. 65,038 × 88,909.
325. 85,700 × 98,476.
326. 65,839 × 42,600.
327. 64,870 × 20,300.
328. 77,869 × 97,800.
329. 98,653 × 55,700.
330. 75,060 × 91,400.
331. 46,054 × 78,000.
332. 62,900 × 98,653.
333. 48 × 25,380.
334. 32 × 26,490.
335. 437 × 36,090.
336. 528 × 45,070.
337. 6,219 × 43,170.
338. 3,458 × 75,640.

339.	360 ×	41,025.	**366.**	4,720 ×	769,000.
340.	470 ×	70,385.	**367.**	2,970 ×	948,000.
341.	4,680 ×	63,207.	**368.**	4,680 ×	538,000.
342.	6,780 ×	72,036.	**369.**	4,500 ×	563,000.
343.	57,930 ×	70,319.	**370.**	5,600 ×	683,000.
344.	75,380 ×	54,305.	**371.**	38,700 ×	739,000.
345.	860 ×	23,950.	**372.**	47,600 ×	895,000.
346.	570 ×	67,480.	**373.**	463,700 ×	648,000.
347.	3,740 ×	64,030.	**374.**	350,900 ×	683,000.
348.	6,380 ×	32,040.	**375.**	84,000 ×	596,000.
349.	83,270 ×	80,320.	**376.**	497,000 ×	394,000.
350.	25,640 ×	90,450.	**377.**	257,000 ×	379,000.
351.	950 ×	87,600.	**378.**	859,000 ×	973,000.
352.	760 ×	54,300.	**379.**	184,000 ×	789,000.
353.	4,830 ×	25,600.	**380.**	639,000 ×	738,000.
354.	3,640 ×	34,800.	**381.**	19,307 ×	207,019.
355.	8,090 ×	60,500.	**382.**	407,079 ×	604,807.
356.	4,070 ×	38,500.	**383.**	704,896 ×	704,098.
357.	474,700 ×	65,300.	**384.**	407,091 ×	376,546.
358.	3,600 ×	84,700.	**385.**	79,004 ×	47,300.
359.	83,600 ×	96,700.	**386.**	65,430 ×	37,600.
360.	54,800 ×	96,700.	**387.**	50,103 ×	65,030.
361.	90,600 ×	34,800.	**388.**	943,600 ×	67,490.
362.	80,500 ×	56,300.	**389.**	80,460 ×	392,000.
363.	4,960 ×	724,000.	**390.**	10,023 ×	5,412,384.
364.	3,580 ×	649,000.	**391.**	13,560 ×	145,800.
365.	3,290 ×	645,000.	**392.**	19,380 ×	193,780.

393. If 6 car tickets cost 25 cents, what will be the cost of 60? of 600? of 6000? of 24,000? of 48,000?

394. A barrel of kerosene oil holds 42 gallons. How many gallons are there in 10 barrels? in 60 barrels? in 600 barrels? in 12,000 barrels?

395. 2000 pounds are a ton. How many pounds in 10 tons? in 50 tons? in 500 tons? in 100,000 tons?

396. If 4860 pounds of manure are spread over 1 acre of land, how many pounds are required for 5 acres? for 7 acres? for 8 acres? for 9 acres?

397. If an acre of corn is worth $27, what is the value of the corn raised on 12,106 acres?

398. A ship brought home 379 boxs of oranges, each containing 258 oranges. How many oranges are there in all?

399. An army consists of 18 regiments, each containing 950 men. Each soldier wears out 3 pairs of boots in a year. What will it cost to provide this army with boots for 2 years, at $4 per pair?

400. On New Year's Day a man stopped drinking, and began to give his wife every week the sum of $2, which was the amount he used to spend on the average for drink. She saved the money, and at the end of the year she bought with it a sofa for $35, an easy-chair for $17, and 5 parlor chairs, at $6 each. After paying for these things, how much money did she have left?

401. A clock strikes 156 times a day. How many times does it strike in a leap year (366 days)?

402. A railroad 57 miles long cost $10,390 a mile. What was its entire cost?

403. Multiply the sum of eighty-five and ninety-three by their difference.

404. A train starts at 7 o'clock in the morning, and travels at the rate of 33 miles an hour. How many miles will it have travelled by 2 o'clock in the afternoon?

405. If a swallow destroys daily 500 insects, how many will it destroy in 4 months of 30 days each?

406. Light travels 185,000 miles a second. How many miles will it travel in eight minutes of 60 seconds each?

407. A dozen dozen is called a gross. How many steel pens are there in 27 gross?

408. If the rate of a steamer is 15 miles an hour, how many miles will it pass over in 8 days of 24 hours each?

409. A butcher bought 42 sheep, at $6 each, and 16 calves, at $9 each. What was the cost of the sheep? the calves? both together?

410. A certain book contains 184 pages. Each page contains 32 lines, and each line has on the average 11 words. How many words are there in the book?

411. A wholesale dealer bought 144 boxes of eggs, each box containing 72 dozen. How many eggs did he buy?

412. There are 24 hours in 1 day. How many hours are there in 1 month of 30 days? in 1 year of 365 days? How many hours has Louis lived, who is 9 years 2 months and 6 days old?

413. A man earns $75 per month, his wife $37, and his son $48. How much will all three earn in one year?

414. Multiply each number from 10 to 20 by 10, 11, 12, etc., to 20, and arrange the factors and their products in a table like the Table of Multiplication.

Find the quotients of:

415. $36 \div 2$.
416. $45 \div 3$.
417. $68 \div 4$.
418. $75 \div 5$.
419. $84 \div 6$.
420. $91 \div 7$.
421. $72 \div 8$.
422. $90 \div 9$.
423. $85 \div 5$.
424. $92 \div 4$.
425. $87 \div 3$.
426. $95 \div 5$.
427. $73 \div 2$.
428. $49 \div 3$.
429. $57 \div 4$.
430. $82 \div 5$.
431. $69 \div 6$.
432. $79 \div 7$.
433. $95 \div 8$.
434. $39 \div 9$.
435. $87 \div 7$.
436. $77 \div 4$.
437 $88 \div 3$.
438. $99 \div 5$.
439. $862 \div 2$.
440. $714 \div 3$.
441. $876 \div 4$.
442. $840 \div 5$.
443. $882 \div 6$.
444. $875 \div 7$.
445. $384 \div 8$.
446. $711 \div 9$.
447. $623 \div 7$.
448. $936 \div 8$.
449. $860 \div 4$.
450. $945 \div 3$.
451. $715 \div 2$.
452. $443 \div 3$.
453. $275 \div 4$.
454. $412 \div 5$.
455. $419 \div 6$.
456. $592 \div 7$.
457. $390 \div 8$.
458. $868 \div 9$.
459. $594 \div 7$.
460. $583 \div 4$.
461. $819 \div 5$.
462. $725 \div 6$.
463. $9374 \div 2$.
464. $7845 \div 3$.
465. $9736 \div 4$.
466. $6835 \div 5$.
467. $8142 \div 6$.
468. $9002 \div 7$.
469. $6776 \div 8$.
470. $4212 \div 9$.
471. $6951 \div 7$.
472. $4560 \div 8$.
473. $5310 \div 9$.
474. $3656 \div 8$.
475. $5937 \div 2$.
476. $5930 \div 3$.
477. $3715 \div 4$.
478. $4123 \div 5$.
479. $5633 \div 6$.
480. $9984 \div 7$.
481. $7435 \div 8$.
482. $5179 \div 9$.
483. $9265 \div 8$.
484. $6345 \div 8$.
485. $4187 \div 9$.
486. $3009 \div 8$.
487. $5372 \div 2$.
488. $8547 \div 3$.
489. $5180 \div 4$.
490. $9745 \div 5$.
491. $5670 \div 6$.
492. $8533 \div 7$.
493. $4783 \div 2$.
494. $8626 \div 3$.
495. $9581 \div 4$.
496. $7394 \div 5$.
497. $8325 \div 6$.
498. $5039 \div 7$.

Divide by 2; by 3; and so on to 9:

499. 9437.
500. 5179.
501. 6392.
502. 8765.

Divide by 20; by 30; and so on to 90:

503. 4791.
504. 6783.
505. 9572.
506. 8327.

Divide by 200; by 300; and so on to 900:

507. 9759.
508. 9684.
509. 9985.
510. 9564.

Find the quotients of:

511. 7,468 ÷ 63.
512. 4,687 ÷ 73.
513. 6,874 ÷ 84.
514. 8,746 ÷ 94.
515. 8,913 ÷ 25.
516. 9,138 ÷ 35.
517. 5,389 ÷ 46.
518. 3,895 ÷ 56.
519. 6,958 ÷ 67.
520. 9,586 ÷ 77.
521. 5,869 ÷ 88.
522. 8,695 ÷ 99.
523. 59,384 ÷ 21.
524. 93,845 ÷ 31.
525. 38,459 ÷ 42.
526. 24,637 ÷ 52.
527. 84,593 ÷ 63.
528. 45,938 ÷ 73.
529. 74,958 ÷ 84.
530. 49,587 ÷ 94.
531. 95,874 ÷ 25.
532. 58,749 ÷ 35.
533. 87,495 ÷ 46.
534. 72,463 ÷ 56.
535. 56,789 ÷ 67.
536. 67,895 ÷ 77.
537. 78,956 ÷ 88.
538. 89,567 ÷ 98.
539. 95,678 ÷ 29.
540. 45,678 ÷ 39.
541. 56,789 ÷ 14.
542. 67,895 ÷ 15.
543. 78,956 ÷ 16.
544. 89,567 ÷ 17.
545. 95,678 ÷ 18.
546. 56,789 ÷ 19.

547. 278,356 ÷ 22.
548. 802,005 ÷ 34.
549. 415,920 ÷ 46.
550. 502,080 ÷ 58.
551. 758,213 ÷ 16.
552. 329,457 ÷ 14.
553. 278,356 ÷ 32.
554. 802,005 ÷ 44.
555. 415,920 ÷ 56.
556. 502,080 ÷ 68.
557. 758,213 ÷ 17.
558. 329,457 ÷ 13.
559. 278,356 ÷ 42.
560. 802,005 ÷ 54.
561. 415,920 ÷ 66.
562. 502,080 ÷ 78.
563. 758,213 ÷ 18.
564. 329,457 ÷ 17.
565. 278,356 ÷ 52.
566. 802,005 ÷ 64.
567. 415,920 ÷ 76.
568. 502,080 ÷ 88.
569. 758,213 ÷ 19.
570. 329,457 ÷ 18.
571. 83,216 ÷ 101.
572. 32,168 ÷ 102.
573. 21,683 ÷ 203.
574. 16,832 ÷ 205.
575. 68,321 ÷ 306.
576. 54,289 ÷ 407.
577. 42,895 ÷ 512.
578. 28,954 ÷ 613.
579. 89,542 ÷ 724.
580. 95,428 ÷ 836.
581. 79,382 ÷ 947.
582. 93,827 ÷ 958.
583. 84,596 ÷ 675.
584. 45,968 ÷ 583.
585. 59,684 ÷ 768.
586. 96,845 ÷ 859.
587. 68,459 ÷ 964.
588. 73,821 ÷ 485.
589. 38,217 ÷ 576.
590. 82,173 ÷ 658.
591. 21,738 ÷ 783.
592. 17,382 ÷ 877.
593. 94,658 ÷ 987.
594. 46,589 ÷ 999.
595. 654,321 ÷ 305.
596. 888,333 ÷ 326.
597. 678,901 ÷ 958.
598. 496,432 ÷ 434.
599. 563,497 ÷ 567.
600. 718,584 ÷ 432.
601. 654,321 ÷ 407.
602. 888,333 ÷ 528.
603. 678,901 ÷ 964.
604. 496,432 ÷ 572.

605. A straw-shop can make 350 hats a day. How many days will it take to fill an order for 28,000 hats?

606. How many times can 239 be subtracted from 4302?

607. What number multiplied by 79 will give the same product as 279 multiplied by 553?

608. How many 6-pound packages of buckwheat flour can be made from 15,000 pounds of the flour?

609. A salt dealer put up 44,000 pounds of salt, in boxes holding 20 pounds each. How many boxes were required?

610. A society of 3240 persons went on a excursion. How many cars were required to carry them, allowing 72 to each car?

611. How many weeks will it take a man to dig a ditch 864 feet long, if he can dig 48 feet a day?

612. The dividend is 3856, the quotient 142, the remainder 22. Find the divisor.

613. If 8 dozen shirts cost $192, how much is this a dozen? How much for each shirt?

614. A ship sailed from Liverpool to the Cape of Good Hope, a distance of 7000 miles, in 50 days. What was her average daily rate?

615. The New Testament contains 260 chapters. How many days will it take a person to read through it, if he reads a chapter every morning and 3 every evening?

616. A mile contains 5280 feet. How many times will a wheel 11 feet in circumference turn in going a mile?

617. If sound travels 1060 feet a second, and a cannon is fired at a distance of 16,960 feet, how many seconds will intervene between the flash and the report?

618. The area of British India is 1,004,616 square miles, and the population 150,767,851. How many persons are there to a square mile?

619. A railroad is 81 miles long, and cost $1,000,000 lacking $55. What did it cost per mile?

620. A page of a book contains 36 lines and 2052 letters. How many letters on the average are there in a line?

621. The dividend is nine hundred and eighty-seven, the quotient fifty-four, and the remainder fifteen. What is the divisor?

622. A shoe dealer bought 4 dozen pairs of shoes for $96, and sold them at $3 a pair. What was his profit?

623. I bought 14 watches for $756. What must be my selling price in order to gain $6 on each watch?

624. In Iowa, in 1880, 260,192,840 bushels of corn were raised. The area planted was 6,847,180 acres. What was the average yield per acre in bushels?

625. One day a fruit peddler sold 288 oranges. His profit on each dozen was 3 cents. How many cents was his profit on them all?

626. A man agreed to dig a ditch through a meadow for $200. It took him 80 days to do the work. How much did he receive a day?

627. A cider merchant made 12,000 gallons of cider, which he put into casks holding 42 gallons each. How many full casks did he have?

628. How many days will 72 bushels of oats last 12 horses, if each horse is allowed 6 quarts a day? One bushel contains 32 quarts.

629. 68,179,600 pounds of pork were exported from the United States in the year 1882. How many barrels of 200 pounds each were exported?

630. In 1880, 25,519,200 bushels of oats were raised in Ohio. The number of acres sown was 911,200, and the total value of the oats was $8,676,528. What was the average yield per acre, and what was the average value per bushel?

631. A man bought 9 cows for $378, and sold them for $4 more for each cow than he gave. What did he pay for each cow, and how much did he receive from the sale of all of them?

632. The total cost of publishing 3600 copies of a pamphlet was $282. If 1400 copies have been sold, at 12 cents each, how many more copies, at 10 cents each, must be sold to pay expenses?

633. How many States of the size of Rhode Island could be made out of the State of New York, and how much would be left over? (For data, see page 4.)

634. How many States as large as New York could be made out of Texas, and how much would be left over? (See page 4.)

635. If as many persons die in 33 years as are equal to the entire population, how many persons on an average die annually out of every million?

636. In how many hours will a cistern holding 3330 gallons be filled by a pipe that discharges into it 185 gallons an hour? Also, in how many hours, if another pipe at the same time allows the water to run out at the rate of 74 gallons an hour?

637. In New Jersey, for the year ending July 31, 1883, there were made 186,400,000 bricks, worth $1,480,700. What was the average value per thousand?

From the following data from the census of 1880, find for each State the average yield of tobacco per acre, and the average value per pound:

		Pounds produced.	*No. of acres.*	*Total value.*
638.	Connecticut,	15,487,660	10,070	$2,323,149
639.	Pennsylvania,	34,854,108	29,729	3,485,411
640.	Maryland,	18,841,830	26,726	1,318,928
641.	Virginia,	78,421,860	118,821	6,273,749
642.	North Carolina,	35,724,385	63,229	3,215,195
643.	Kentucky,	149,017,855	224,087	10,431,250
644.	Tennessee,	24,319,890	38,603	2,188,790
645.	Ohio,	38,434,587	35,439	2,306,075

From the data given below, and taken from the census of 1880, find for each State the average yield of cotton per acre, and the average value of the cotton per pound:

		Pounds produced.	*No. of acres.*	*Total value.*
646.	N. Carolina,	184,734,000	933,000	$18,473,400
647.	S. Carolina,	266,696,000	1,441,600	29,336,560
648.	Georgia,	454,166,900	2,786,300	45,416,690
649.	Florida,	35,727,200	251,600	3,215,448
650.	Alabama,	378,932,400	2,460,600	37,893,240
651	Mississippi,	391,300,000	2,275,000	39,130,000
652.	Texas,	550,873,000	2,395,100	49,578,570
653.	Arkansas,	232,243,000	1,080,200	23,224,300
654.	Tennessee,	165,688,600	816,200	14,911,974

Write all the prime numbers between:

655.	1 and 50.	**665.**	500 and 550.
656.	50 and 100.	**666.**	550 and 600.
657.	100 and 150.	**667.**	600 and 650.
658.	150 and 200.	**668.**	650 and 700.
659.	200 and 250.	**669.**	700 and 750.
660.	250 and 300.	**670.**	750 and 800.
661.	300 and 350.	**671.**	800 and 850.
662.	350 and 400.	**672.**	850 and 900.
663.	400 and 450.	**673.**	900 and 950.
664.	450 and 500.	**674.**	950 and 1000.

Resolve into prime factors:

675.	225.	**685.**	504.	**695.**	960.	**705.**	1725.
676.	315.	**686.**	672.	**696.**	1152.	**706.**	27,525.
677.	392.	**687.**	704.	**697.**	1296.	**707.**	11,256.
678.	441.	**688.**	756.	**698.**	1728.	**708.**	87,147.
679.	495.	**689.**	792.	**699.**	2240.	**709.**	1176.
680.	616.	**690.**	1056.	**700.**	1624.	**710.**	2750.
681.	968.	**691.**	240.	**701.**	2925.	**711.**	2555.
682.	1089.	**692.**	486.	**702.**	2254.	**712.**	7755.
683.	405.	**693.**	729.	**703.**	71,001.	**713.**	5544.
684.	448.	**694.**	768.	**704.**	1261.	**714.**	7581.

Find the G.C.M. of:

715.	342, 665.	**719.**	1500, 1565.	**723.**	1650, 960.
716.	720, 1720.	**720.**	6409, 7395.	**724.**	1712, 1872.
717.	2272, 3522.	**721.**	5187, 5850.	**725.**	3708, 3264.
718.	252, 1000.	**722.**	394, 672.	**726.**	2523, 1798.

727. 2067, 3146.
728. 1908, 2736.
729. 384, 1296.
730. 406, 522.
731. 1025, 1575.
732. 7455, 4723.
733. 2883, 2356.
734. 2486, 4407.
735. 3003, 2574.
736. 5550, 4551.
737. 4067, 5146.
738. 1392, 2048.
739. 5325, 8307.
740. 4242, 6565.
741. 4833, 6237.
742. 4972, 4407.
743. 6916, 5850.
744. 3861, 4653.
745. 1442, 7245.
746. 1976, 2340.
747. 1742, 2386.

Find the L.C.M. of:

748. 7, 8, 15, 21, 24.
749. 8, 9, 16, 24, 27.
750. 4, 7, 12, 21, 34.
751. 12, 16, 21, 35, 42, 60.
752. 12, 14, 20, 24, 30.
753. 15, 27, 36, 54, 60, 80.
754. 6, 9, 15, 25, 36, 40, 54.
755. 8, 12, 18, 24, 28, 30.
756. 10, 15, 18, 24, 28, 40.
757. 16, 14, 12, 32, 50, 75.
758. 14, 21, 24, 36, 49, 60.
759. 15, 18, 24, 40, 50, 90.
760. 16, 14, 20, 24, 32, 35.
761. 5, 6, 7, 8, 9, 10, 11, 12.
762. 8, 20, 34, 50, 56, 70, 85.
763. 4, 9, 10, 14, 15, 18, 21.
764. 14, 18, 24, 35, 42, 68.
765. 12, 16, 24, 36, 54, 144.
766. 24, 16, 20, 8, 30, 25, 12.
767. 15, 12, 128, 30, 16, 320.
768. 508, 889.
769. 517, 564.
770. 124, 341, 372.
771. 312, 260, 390.
772. 112, 200, 72.
773. 195, 234, 225.
774. 454, 478, 227.
775. 544, 170, 850.
776. 1025, 1575, 315.
777. 3003, 2574, 1287.
778. 242, 22, 286.
779. 112, 196, 588.
780. 252, 170, 84, 72.
781. 175, 140, 65, 560.
782. 132, 144, 154, 288.
783. 100, 96, 87, 128.
784. 144, 96, 176, 168.
785. 708, 177, 354, 826.
786. 760, 364, 336, 1736.
787. 720, 396, 252, 540.

Miscellaneous.

788. If a bushel of corn is worth 72 cents, what is the value of 100 bushels? of 10,000 bushels? of 40,000 bushels?

789. One man is worth $3240, another 10 times as much, and a third 10 times as much more. What are they all three worth?

790. A cabinet-maker made 14 tables at a cost of $7 each; he sold them at $11 each. How much money did he make?

791. A jeweller sold 17 clocks, at $14 each. He received for pay 24 ten-dollar bills. How much money should he return?

792. A boy can point 13,579 pins in an hour. How many can he point in 6 days, working 9 hours each day?

793. If I buy 60 horses, at $130 apiece, and sell 18 of them at $175 each, and the rest at $115 each, do I gain or lose, and how much?

794. How much more will a man earn in a year, at $25 a month, than at $22.50 a month?

795. A farmer sold 33 cans of milk, at 52 cents a can, and 16 cans, at 58 cents a can. If he is paid $25, how much is still due?

796. In the siege of Gibraltar (1779–1783) the English fired 57,163 round shot, and the French, 175,741. If the average weight of each ball was 18 pounds, how many pounds of iron were fired?

797. A treasury clerk receives $125 a month, and spends $87. How much will he save in one year?

798. My daily paper costs 2 cents on each week day and 5 cents on Sunday. What will it cost for one year having 365 days, 52 of which are Sundays?

799. A pound of platinum is worth $85. The yearly production of platinum in South America is 550 pounds, and in the Ural Mountains 4180 pounds. What is the value of the total yearly production?

800. Fill out the account of the following sale:

9 chamber sets, at $65 each,	$
15 " " " $58 "	
Total,	$
Cash paid,	$875
Still due,	

801. A grocer bought 214 barrels of extra flour, at $8 each, 78 barrels of ordinary flour, at $6 each, and 43 barrels of sugar, at $16 each. Make out an account of the purchase, and find the amount of his bill.

802. A trader sold 4 dozen straw hats, at $2 each, 2 dozen seal-skin caps, at $11 each, and 7 dozen beaver hats, at $6 each. He received $125 cash on the bill. How much is still due him?

803. A stock farmer estimates roughly the value of his stock, as follows: 175 cows, at $46 each; 87 calves, at $8 each; 10 pairs of oxen, at $140 a pair; 4 bulls, at $80 each; 215 sheep, at $12 each; and 160 hogs, at $11 each. How many animals has he in all, and what are they all worth?

804. If the annual sale of dime novels in this country is 600,000 copies, how much money is expended on them in one year?

805. John's father on his sixteenth birthday began to give him half a dollar a week, to use as he pleased. If John spends on the average 10 cents a week, and saves the rest, how much money will he have on his twenty-first birthday?

806. A good cow yields 168 pounds of butter a year. If it takes 215,000 cows to supply London with butter, how many pounds of butter are consumed annually in that city?

807. A farmer has 6 cows that give each 12 quarts of milk daily for 8 months in the year. He sells the milk for 6 cents a quart. How much does he receive for the milk, counting 30 days for each month?

808. A factory employs 220 men, 87 women, and 64 children. Their average weekly wages are: men, $8; women, $5; children, $3. What is the amount of their wages for the year?

809. A fruit seller bought 15 dozen melons, at 10 cents apiece, receiving 13 for each dozen. Ten of the lot were bad, and the rest he sold at 15 cents apiece. What was his profit?

810. Do not kill birds. They destroy the small insects which devour our crops. Certain kinds of birds, as swallows and tomtits, eat as many as 500 insects a day. How many insects will 25 such birds eat in 1 day? in 1 month? in 1 year?

811. The female cockroach lays in the ground on the average 90 eggs. Each egg may give birth to a white worm, which, during the three or four years that it lives in the ground, devours the roots of at least 150 plants. How many plants are saved by a child who kills 260 cockroaches?

812. The mole is a useful animal, for it eats insects which destroy the roots of plants. If a mole kills 3 insects a day, and each insect is able to destroy 18 plants worth 15 cents each, how much money may the mole save for the owner of the plants in a year?

813. How many years from the Deluge, B.C. 2348, to the end of A.D. 1884?

814. Two boys spend a week walking together in the White Mountains. On Monday they walked 20 miles; on Tuesday, 13 miles; on Wednesday, 18 miles; on Thursday, 26 miles; on Friday, 22 miles, and on Saturday, 9 miles. How many miles did they walk during the week?

815. I sold a piece of land for $2175, and thereby lost $75. What did the land cost me?

816. An orchard contains 89 apple-trees, an equal number of pear-trees, 78 peach-trees, an equal number of plum-trees, 17 cherry-trees, and 1 mulberry-tree. How many trees are there in the orchard?

817. One day a dealer in toys sold 127 marbles. The next day he sold as many more. He then had 46 left. How many had he at first?

818. A man has 6 teams, and each team can haul 4 cords of wood a day to market. How many days will it take him to haul 720 cords to market?

819. The area of England is 50,535 square miles; of Scotland, 29,167 square miles; and of Wales, 8,125 square miles. How many more square miles are there in England than in Scotland and Wales taken together?

820. Four loads of hay together weighed 9169 pounds. The first weighed 2007 pounds; the second, 1963 pounds; the third, 2614 pounds. What was the weight of the fourth?

821. I have 272 stamps, and my brother has 25 more than I. How many have we together?

822. A man was born in 1817. When will he be 75 years old?

823. For the fiscal year ending June 30, 1881, the exports and imports of the United States were as follows:

	Exports.	*Imports.*
Merchandise,	$902,367,346	$642,664,628
Specie,	19,406,847	110,575,497

What was the trade balance in favor of the United States?

824. A farmer took $1000 with him to market. He bought a horse for $225, a pair of oxen for $170, a bull for $90, and a carriage for $145. On his way home a part of his remaining money was stolen. When he reached home he found he had only $60 left. How much of his money was stolen?

825. John bought an arithmetic for 45 cents, a reader for 37 cents, a penholder for 4 cents, and a quire of paper for 15 cents. He gave the shopkeeper a two-dollar bill. How much change should he receive?

826. A farmer sold for $490 a horse which cost him $547, and for $310 another horse which cost him $225. Did he gain or lose on the two horses, and how much?

827. A man bought 3 houses. He paid for the first, $5260; for the second, $3585; and for the third, as much as for both the others. He sold them all for $15,979. How much did he lose by the transaction?

828. If 110 sugar-canes yield 6 pounds of sugar, how many pounds will be obtained from 1,233,210 canes?

829. How many solid squares, with 8 men on each side, can be formed out of a million of men?

830. At an election 3795 persons voted, and one of the candidates received 709 votes more than the other. How many voted for each candidate?

831. Shem was 98 years old at the time of the Flood, B.C. 2348, and 600 years old when he died. Abraham was born, B.C. 1996. How old was Abraham when Shem died?

832. Two trains start from the same place at the same time. One travels at the rate of 35 miles an hour, the other at the rate of 25 miles an hour. How far apart will they be after 7 hours, if they travel in *opposite* directions? How far apart if they travel in the *same* direction?

833. Multiply one million and one by three hundred thousand and three.

834. A merchant began business with $20,000, and retired after 17 years' trading. He made $5600 each year for the first 6 years, lost $8476 the next year, and made $7320 a year for the remainder of the time. How much was he worth when he retired from business?

835. A man owns 3 houses. The first is worth $3333, the second is worth 3 times as much as the first, and the third is worth 3 times as much as the first and second together. What is the value of the 3 houses?

836. A certain number exceeds nine dozen and nine by 168. Another number falls short of 189 by eight dozen and eight. Find the product of these two numbers.

837. If 19 oxen cost $1330, and an ox is worth 14 sheep, what is the price of a sheep?

838. A man paid $931 for 49 acres of land, and $98 for fencing it in. He then sold it for $25 an acre. What was his profit?

839. If a woman can make 5 yards of ribbon a day, working 12 hours each day, how many hours must she work in order to make 840 yards?

840. Overall makers in Boston receive 5 cents a pair when made at home, and 50 cents a dozen when made in the shop. If a girl make 2400 pairs at home, how much more will she receive than if she make them in the shop?

841. There were in Ohio, in January, 1883, 774,253 milch cows, valued at $27,098,855. What was the average value of a cow?

842. A grocer bought 5 firkins of butter, containing respectively 42 pounds, 46 pounds, 55 pounds, 38 pounds, and 49 pounds. What was the average number of pounds to a firkin?

843. The attendance at the high school one week was as follows: Monday, 116; Tuesday, 109; Wednesday, 84; Thursday, 96; Friday, 111; Saturday, 120. What was the daily average attendance for the week?

844. If 336 bees weigh an ounce, and 4032 bees fill a quart, how many ounces will a swarm weigh that just fills 2 quarts?

845. How many States, each as large as Massachusetts, could be formed out of Texas, and how much would be left over? (See page 4.)

846. If four new States were formed out of Texas, having the respective areas of New York, New Jersey, Pennsylvania, and Ohio, what area would still be left? (See page 4.)

847. Lake Erie covers 9600 square miles. How much larger is it than the States of Massachusetts and Rhode Island taken together? (See page 4.)

848. Of what number is 1188 both divisor and quotient?

849. What number between 400 and 500, besides 475, will divide 211,850 without a remainder?

850. A confectioner puts up 4000 pounds of assorted candies in 1-pound, 2-pound, and 5-pound packages, of each size an equal number. How many packages did he put up all together?

851. A dealer in horses bought 40 horses at $125 apiece, and sold 15 of them at $105 each. At what price apiece must he sell the others in order to clear $500 by the transaction?

852. Mr. Gage owns a farm valued at $8500, and his life is insured for $10,000. He has also the following stocks:

60 shares Atchison R.R. stock, at $94 a share.
35 " Boston & Albany R.R. stock, at $196 " "
18 " Bell Telephone stock, at $214 " "

His other personal effects are valued at $2400. What are his total assets?

853. A wholesale grocer wishes to put up for market, in packages of equal weight, 4000 pounds of oatmeal and 3144 pounds of cracked wheat. He also wants to have as few packages as possible. What is the least number of packages he can have, and what is the weight of each package?

854. Half the sum of two numbers is 412, and half their difference is 40. What are the numbers?

855. A certain school is attended by 112 boys and 147 girls. What is the smallest possible number of classes which can be formed, each class to contain the same number of scholars, and to consist entirely of boys or entirely of girls?

856. What is the smallest number of dollars that can be divided into piles, either of $5 each, or of $4 each, or of $2 each?

857. A man paid $1450 for a farm, $325 for drainage, $80 for fencing, and $420 for labor. The gross proceeds for one year amounted to $2975. With the profits he buys sheep at $5 each, and cows at $23 each, of each the same number. How many animals of each kind does he buy?

858. On July 1, 1871, the debt of the United States, less cash in the treasury, was $2,292,030,835. By July 1, 1885, it had been reduced to $1,386,555,523. What was the average reduction per annum for the whole of this period?

859. The foreign immigration into the United States during the 10 years ending June 30, from 1876 to 1885 inclusive, was as follows:

1876,	169,986.	1881,	669,431.
1877,	141,857.	1882,	788,992.
1878,	138,469.	1883,	603,322.
1879,	177,826.	1884,	518,592.
1880,	457,257.	1885,	395,346.

What was the total number, and what was the average for each year?

860. The revenue and expenditure of the United States in dollars, as estimated by the secretary of the treasury and in actual amount, for the fiscal year ending June 30, 1885, were as follows:

	Estimated.	*Actual Amount.*
Revenue,	330,000,000.	323,690,706.
Expenditure,	243,000,000.	260,226,935.

How far was the secretary out of the way in each estimate? What was the surplus for the year?

861. A house-builder bought a house for $2637, and spent $247 in repairing it; he then sold it for $3000. What did he gain?

862. Harry is reading a book of 524 pages; he is now at page 228. How many pages has he still to read? If to-morrow he reads 78 pages, and the next day as many more, at what page will he then be? How many pages will then remain to be read?

863. One spring supplies 119 barrels of water in 7 hours; another, 390 barrels in 15 hours; and a third, 324 in 18 hours. In how many hours will the three springs together fill a cistern holding 1647 barrels?

864. A clerk agreed to work for a yearly salary of $1460. How much was that a day? He was discharged at the end of 5 months. How much is still due him, if he has already received $85?

865. A publisher sold 1500 copies of a book for $1020, and thereby made a profit of $150. Find the cost, the selling price, and the profit per hundred copies.

866. A button-hole maker earned in one month of 26 working days $52. She did 800 button-holes a day, and is paid at the rate of 25 cents per hundred. How many button-holes did she do during the month?

867. Mr. Fernald never gets home to supper till after 6 o'clock. His wife once kept an account for 30 days, and found that he was 15 minutes late 7 times, 18 minutes late 5 times, 20 minutes late 8 times, 25 minutes late 5 times, and half an hour late 5 times. What is Mr. Fernald's average time of getting home to supper?

CHAPTER II.

DECIMAL FRACTIONS.

1. Decompose the following numbers into their different orders of units:

0.6.	12.308.	9.123456.
0.14.	17.150.	36.008090.
0.543.	43.7209.	567.0086.
0.4305.	67.8070.	157.00007.
0.0567.	1.21037.	589.40027.
0.0031.	0.01567.	0.5679357.
0.0507.	0.00896.	0.5612389.
0.4925.	0.04236.	0.0000768.
2.35.	0.00009.	0.0317897.
4.654.	0.00900.	0.0100059.

2. Read the numbers in the preceding exercise, pronouncing first the integral part, and then the decimal part.

3. Write the following numbers: three hundredths; four hundred two thousandths; three thousand two hundred twenty-five ten-thousandths; twenty-seven thousand two hundred twenty-six hundred-thousandths; ninety-seven and two hundred eighteen thousandths; fifteen hundred-millionths; one million and seventeen ten-millionths; one million seventeen ten-millionths; eighty-three thousand and twenty-seven thousandths; eight thousand four ten-thousandths.

4. What place after the decimal point is the place of thousandths? hundred-thousandths? hundredths? millionths? ten-millionths? ten-thousandths?

5. In a decimal number, what is the name of the order of units written in the first decimal place? in the third? the fifth? the seventh? the fourth? the second? the sixth?

6. Multiply by 10, 100, 1000 the numbers: 3.05; 4.538; 8.5.

7. Divide by 10, 100, 1000 the numbers: 32.8; 318.4; 4.825.

8. Reduce 40,000 cents to dollars. Reduce 75 dollars to cents.

Add:

9.	10.	11.	12.
17.24	52.38	30.709	27.6090
42.73	367.4	0.80063	0.0046
12.06	0.172	96.40	3.4603
96.32	6.0053	0.210	0.034
9.60	9005.079	46.90050	56.90

13. $5678.0036 + 12.897 + 0.11593 + 0.612 + 1.651$.

14 $0.60105 + 0.00015 + 412.685 + 0.115 + 1.61 + 0.18$.

15. $2.012 + 0.191 + 0.768960 + 71.02$.

16. $707.60149 + 0.0000619 + 810.5 + 0.320 + 0.0409$.

17. $4.37805 + 0.04459 + 600.2$.

18. $806.78943 + 0.897601 + 1.2 + 8.97641 + 0.006 + 8.654$.

19. $7089.7642 + 8.9645 + 9.8764 + 102.67 + 789 + 1.870$.

20. $0.501276 + 286.78 + 8.791 + 0.64218 + 54.897 + 0.8964$.

21. $0.305412 + 210.0015 + 2000.56 + 0.00001 + 4$.

22. Eighteen and seventeen hundredths; seven hundred seventy-seven ten-thousandths; seven and four hundred thirty-two thousandths.

Add:

23. One and eighteen ten-thousandths; two and four hundred ten-thousandths; eighty-five ten-thousandths; three hundred sixteen thousandths; ninety-five hundredths; one thousand eight ten-thousandths; seventeen hundred-thousandths; four and four thousand eighty-nine hundred-thousandths.

24. Fourteen; fourteen tenths; fourteen hundredths; fourteen thousandths; fourteen ten-thousandths; fourteen hundred-thousandths; fourteen millionths; fourteen ten-millionths; fourteen hundred-millionths.

25. 12 eagles; 44 dollars; 168 dimes; 6927 cents.

26. 87 thousand-dollar bills; 1260 hundred-dollar bills; 378 gold eagles; 5500 dollars; 42317 dimes; 98 cents.

27. A shoemaker presented the following bill for his services. Correct the mistake in the addition.

1884.		
May 15.	1 pair of custom boots,	$14.50
June 17.	1 pair of congress boots,	4.75
July 19.	1 pair of children's shoes,	2.25
Aug. 7.	Repairing,	1.87
Oct. 9.	1 pair of fancy slippers,	3.40
Dec. 4.	1 pair of ladies' boots,	6.75
	Total,	$34.52

28. The separate items of an account on four pages of a ledger were as follows. What is the whole amount?

$2.45	$2.40	$4.72	$19.27
13.60	5.17	15.25	6.42
9.70	91.60	37.40	12.33
8.85	217.70	25.60	3.07
10.80	7.48	200.45	2.69

29. A newsboy's sales on Monday amounted to $1.68; on Tuesday, to $2.04; on Wednesday, to $2.46; on Thursday, to $1.88; on Friday, to $0.95; and on Saturday, to $3.24. What was the amount for the week?

30. I bought a field for $877.50, and paid $88.27 for fencing and draining. At what price must I sell the land in order to make $125.50?

31. By selling a cow for $32.50 I lost $4.67. For how much should I have sold her to gain $8.50?

32. The main line of a railroad is 114.38 miles in length. There are four branches whose lengths in miles are respectively, 9.17, 22.05, 11.44, and 12.15. What is the entire length of the road?

33. A lady bought at a dry-goods store 4 dozen buttons, for $1.20; 1 comb, for $0.87½; 1 bottle of rose water, for $0.70; 6 towels, for $1.98; 1 belt, for $1.12½; 1 sack, for $16.25; 1 purse, for $2.75; and 1 penknife, for $0.45. What was the amount of her bill?

Find the difference between:

34. 174.29 and 49.62.

35. 14.5389 and 5.870.

36. 15.136 and 0.89764.

37. 0.5475 and 0.4212.

38. 0.875 and 0.525.

39. 0.275 and 0.198.

40. 5.25 and 3.875.

41. 3.125 and 1.9375.

42. 8.425 and 5.3875.

43. 1.25 and 0.175.

44. 2.834 and 2.786.

45. 3.245 and 1.2375.

46. 1.1 and 0.0009.

47. 10 and 0.000010.

48. From thirteen hundred one and one hundredth take eleven hundred eighty-nine and twenty-five thousandths.

49. From the sum of three hundred nineteen dollars twenty-five cents and fourteen dollars one cent take two hundred eighteen dollars seven cents.

50. From the sum of 3.0045, 19.028, and 32.4009, take the difference between 63.4 and 9.004.

51. Find the difference between two and four hundred fifty-seven thousandths minus one and sixty-eight hundredths, and fourteen and five tenths minus seven and eighty-eight thousandths.

52. How much greater is the sum of seven thousand four hundred sixty-seven and one thousandth than the difference between five and nine hundred-thousandths?

53. Subtract 387 cents from $387.

54. Subtract 24,000 cents from $8400.

Find the following differences:

55. 53.0718 − 51.89712.

56. 1.05689 − 0.6873045.

57. 54.91204 − 46.00036.

58. 15.10246 − 0.54056.

59. 0.2001234 − 0.01069.

60. 0.040621 − 0.0213.

61. 64.89767 − 50.81789.

62. 90.3217 − 72.02134.

63. 90.6438 − 89.76432.

64. 2.959656 − 1.5645.

65. 15.896 − 12.0716897.

66. 9.03 − 0.90003.

67. A lady bought a sewing-machine for $37.50. She gave in exchange her old machine, valued at $9.75, and the balance in money. How much money did she pay?

68. The Boston and Maine Railroad Company, in 1883, operated 203.84 miles of road, of which 58.76 was double track. How much was single track?

69. The distance from New York to Chicago by the New York Central and Lake Shore route is 982.24 miles. The distance from New York to Buffalo is 441.75 miles. What is the distance from Buffalo to Chicago?

70. John bought a cap for $1.63, a pair of boots for $3.75, and a pair of skates for $2.10. He gave the salesman a ten-dollar bill. How much money should be given back?

71. At night the mercury of the thermometer stood at 44.7 degrees; in the morning it stood at 28.8 degrees. How many degrees did it fall during the night?

72. Before a storm the mercury in a barometer fell from 30.292 inches to 29.347 inches. How many inches did it fall?

73. New Year's Day my father gave me $3.50; my mother, $2.25; and my two aunts, $0.80 each; and I bought a present for my sister, costing $4.25. How much money have I left?

74. One pound of dry oak-wood when burnt yields 0.022 pounds of ashes. What part of the pound disappears in the air?

75. An ice-house contained 1000 tons of ice. The owner sold at different times, 242.765 tons, 87.125 tons, and 166.375 tons. He then found that he had 480.042 tons left. How much had been lost by melting?

76. The revenues of the United States for the fiscal year ending June 30, 1883, were: customs, $214,706,496.93; internal revenue, $144,720,368.98; other sources, $38,860,-716.04. The expenditures for the same period were $265,408,137.54. What was the surplus for that year?

77. The heights of the barometer observed on four successive mornings were as follows: 29.74 inches, 29.62 inches, 29.4 inches, and 29.55 inches. What was the average height for this period?

78. How much must be added to nine thousandths in order to obtain the whole number nine? How much in order to obtain nine thousand?

Find the products of:

79.	5.27×4.83.	**88.**	4.36×219000.
80.	4.36×2.19.	**89.**	7.43×0.067.
81.	1.89×0.76.	**90.**	2.06×21.716.
82.	2.38×3.47.	**91.**	4.36×0.0219.
83.	5.62×0.213.	**92.**	5.62×0.0213.
84.	2.78×0.547.	**93.**	2.78×0.0213.
85.	5.27×0.00483.	**94.**	7.19×1.012.
86.	18.9×0.000076.	**95.**	6.78×11.007.
87.	52.7×48300.	**96.**	5.69×30.800.

97. Three hundred twenty-seven ten-thousandths by four hundred eight thousandths.

98. Four millionths by nine ten-thousandths.

99. Three hundred seventeen millionths by one hundred seventy-nine ten-thousandths.

100. Thirty-four thousand five hundred sixty-four millionths by fifteen hundred-thousandths.

101. Four hundred ninety-five millionths by eight hundred four ten-thousandths.

102. Nine hundred twenty-five dollars sixteen cents and eight mills by three and seventeen thousandths.

103. Twelve hundred seventy-five dollars by twelve hundred seventy-five ten-thousandths.

104.	7896.01×6.8970.	**110.**	0.7639×763900.
105.	0.44068×0.0024.	**111.**	0.0009×0.0983.
106.	0.18961×1.15.	**112.**	380.460×23.40.
107.	42.6008×0.204.	**113.**	84.459×0.54.
108.	0.78964×1.2565.	**114.**	78.924×3.6100.
109.	5.78934×0.0763.	**115.**	7642.8×6.564.

Find the quotients of:

116. $1.7503 \div 7.61$.

117. $39.538 \div 0.53$.

118. $392.37 \div 31.9$.

119. $5.2441 \div 22.9$.

120. $228.75 \div 30.5$.

121. $89645 \div 1.05$.

122. $3.162 \div 79.05$.

123. $27.09 \div 0.047$.

124. $5.765 \div 2.5$.

125. $0.736 \div 200$.

126. $9.216 \div 0.0256$.

127. $0.817 \div 0.9147$.

128. $78.1 \div 1.071$.

129. $918 \div 914.71$.

130. $213 \div 91.614$.

131. $17.5 \div 1.15$.

132. $24.8 \div 400$.

133. $300 \div 0.015$.

134. Multiply sixty-two hundredths by sixty-two hundredths, and divide the product by four ten-thousandths.

135. Divide five hundred seventy-nine by seventy-five thousandths, and from the quotient subtract eighteen hundred-thousandths.

136. Multiply 3.15 by 0.315, and divide the product by 2.5.

137. Divide five thousand six hundred by twenty-eight hundredths, and to the quotient add fifteen and nine hundredths.

138. Divide fifty dollars seventy-five cents by forty-six, and add five cents to the quotient.

139. $110.925 \div 1.53$.

140. $1109.25 \div 0.0153$.

141. $0.39237 \div 3190$.

142. $0.39538 \div 5300$.

143. $0.52441 \div 22900$.

144. $0.78895 \div 15.5$.

145. $20973.6 \div 0.8739$.

146. $9110.64 \div 2900$.

147. $0.03486 \div 4.98$.

148. $175.030 \div 76100$.

149. $0.62825 \div 1.75$.

150. $7.00727 \div 0.029$.

Miscellaneous.

151. Add five and 394 · thousandths; 85 ten-thousandths; seventy-five and 19 hundredths; 1009 ten-thousandths; five hundred eighty-nine and 300 ten-thousandths; 108 ten-thousandths.

152. Subtract 325 thousandths from 325.

153. The subtrahend is four hundred eight ten-thousandths, the minuend is ninety-five hundredths. Required the remainder.

154. Simon Day bought six horses: for the first he paid $107.09; for the second, $87; for the third, $98.02; for the fourth, $53.75; for the fifth, $83.25; and for the sixth, $115.95. Required the cost of all.

155. Two men starting from the same place travelled in opposite directions, one going 595.25 miles; the other, 789.01 miles. How far apart were they, and how much farther did one travel than the other?

156. From five trees 76 bushels of apples were gathered; one bore 12.07 bushels; another, 15.25; another, 17.01; another, 16. What was the yield of the fifth?

157. John Greene had $1000 deposited in a bank; he paid for rent, $150; to the butcher, $125.13; to the grocer, $148.10; to his tailor, $30; for taxes, $37.80; and gave $60.75 for charities. What sum remained to his credit in the bank?

158. A man earned in a week, $6.07; in another, $7.03; in another, $11.25. He paid from this for board, $7.08; for boots, $3.25; for car-fare, $0.75; and for collars, $1.25. How much remained?

159. A man made 15.09 rods of fence in one day, 17.2 the next, 12 the next, and 16.4 the next; a hurricane carried away 13.9 rods and displaced 12.12 rods. How many rods of perfect fence remained?

160. A meat bill for the several days of the week was \$4.25, \$3, \$4.18, \$3.06, \$2.17, \$5.03. On Wednesday \$5.18, on Friday \$3.01, were paid. What was the balance due after Saturday's purchases?

161. A merchant, from a bin of coal containing 70 tons, sold at different times 15.05, 18.9, 25.01 tons. After these sales he put in 13.08 and 0.25 tons. How many tons were there then in the bin?

162. Abraham Arnold began farming with \$1784. He bought a horse for \$87.25, farm implements for \$385, furniture for \$490.75, repaired his house at an expense of \$275.01, bought stock for his farm to the amount of \$409.17; he then received a legacy of \$1350.40. How much money had he left after all his bills were paid?

163. A drover bought four horses. For the first he paid \$97.25; for the second, \$25 more than for the first; for the third, the sum of the cost of the first and second; for the fourth, \$240.825. He sold them all so as to gain the difference between the cost of the first and last. What was his gain, and what did he receive for the whole?

164. Hiram James owes to one man \$1000; to another, \$75.02; to another, \$198.75; and to a fourth, \$325.50. How much money will he need to pay these debts and have \$2189.84 to begin business?

165. The difference between two cargoes of coal is 3754.0009 tons, and the smaller cargo has 2789.01 tons. Required the number of tons in the larger cargo.

166. What is the cost of 8.5 yards of cloth at $0.75 per yard?

167. How many yards of cloth at $0.125 per yard can be bought for $45.625?

168. Eleven and seventy-five hundredths tons of coal cost eighty-two dollars and twenty-five cents. What will be the cost of twenty-one and four-tenths tons?

169. A five-dollar bill was given to pay for 16.4 pounds of sugar at $0.125 per pound. What change should be given back?

170. A case of five dozen collars cost $8.70. For what must they be sold apiece to bring $10.20, and what will be the gain on the whole?

171. A grain merchant spent $303.75 for equal quantities of rye at 60 cents, and corn at 75 cents per bushel. How many bushels of each grain did he buy?

172. A man bought 80 yards of cotton cloth for $18.40, and had made from it 2 dozen shirts. Find the price of the cloth per yard, and the cost of a shirt, if the expense of making the 2 dozen shirts is $6.80.

173. A person has spent $1300 during the first 7 months of a common year; how much must he diminish his daily expense in order that his total expense for the year may not exceed $2000?

174. A person wishes to have made 5 dozen shirts from material which costs 25 cents a yard. It takes 2.5 yards for a shirt, and he hires a woman to make them, paying her $2 a week. She makes 2 shirts every 3 days. Find the total expense, and the cost of one shirt.

175. On the first of March a man bought 148 yards of cloth at 55 cents a yard. Fifteen days later the same cloth fell 4 cents a yard, and he purchased then 200 yards. He wishes to sell the whole so as to gain $11; what must be the selling price per yard?

176. Paul planted 17 dozen peach-stones which he bought at the rate of 3 cents a hundred. He raised 119 peach-trees, which he grafted, and sold at 6 cents apiece. He grafted upon quince-stalks 150 pear-scions, which he sold all together for $11.27. Find the cost of the peach-stones, the price of a single pear-tree, and the amount of his two sales.

177. Barrel-hoops are made from young trees. If from a cord of these trees 720 hoops can be made, how many cords will be required for 60 barrels, 30 hoops to a barrel, and what is the value of a cord of wood fit for hoops, reckoning the hoops at $15 a thousand?

178. A sheep-raiser shears his sheep at an expense of 3 cents a head. The sheep average 8 pounds of wool, which he sells for 22 cents a pound, and finds that his net profit after paying for the shearing is $2595. How many sheep had he?

179. A field of wheat of 8.5 acres produces 300 sheaves per acre, and two sheaves of wheat furnish a bundle of straw weighing 10 pounds. What is the value of the whole straw, at the rate of $12 per ton? (A ton is 2000 pounds.)

180. A horse requires 10 pounds of hay a day besides his grain. A man who owns 3 horses has harvested 5 acres of grass, obtaining 5000 pounds of hay an acre. For how much can he sell his crop, if he reserves enough to last his horses a year, and sells the rest at $15 a ton?

181. A farmer carries to market 64 sacks of wheat which weigh 120 pounds each. He sells these at the rate of $2.50 for 100 pounds. With the money he purchases a horse, and has $45.50 left. What does he pay for the horse?

182. Powder contains in every 100 parts by weight 75 parts of saltpetre 12.5 of sulphur, and 12.5 of charcoal. How much of each of these substances is required to make a ton of powder? (2000 pounds.)

183. Find the time which a locomotive with the velocity of 27 miles an hour would take to make the distance passed over in 13.25 hours by another locomotive, having the velocity of 43.5 miles an hour.

184. A stick 4.5 feet long standing upright casts a shadow 10 feet long. What is the height of a column which at the same time casts a shadow 75 feet long?

185. Seventy-five hundredths of a piece of cloth was sold for $86.40 at the rate of $1.60 a yard. Find the length and value of the whole piece.

186. A man wishes to exchange 6 barrels of vinegar, each containing 29 gallons, at 36 cents a gallon, for wine valued at $3.00 a gallon. How many gallons of wine should he receive?

187. A person bought 2.5 pounds of candles at 28 cents a pound, 1.5 pounds of coffee at 36 cents a pound, 3.75 pounds of brown sugar at 8 cents a pound, 1.25 pounds of tea at 80 cents a pound. He gave a five-dollar bill in payment. How much change should he receive?

188. A merchant buys eggs for $28.50 at the rate of $1.90 a hundred. How many dozen, and at what price a dozen, does he sell them to gain $2.75 upon his purchase?

189. A workman who makes $3.25 a day saves $300.00 a year. He rests Sundays and eight other days. How much does he spend a day?

190. It is estimated that one pound of butter can be made from 10.5 quarts of milk, and that a good cow will furnish annually 300 pounds of butter. How many quarts of milk will the cow give in a year, and what will be the income, supposing that the butter is sold at the rate of 28 cents a pound? and which is more profitable, to make butter or to sell milk at 2.5 cents a quart?

191. A bushel of wheat weighs 60 pounds. It is found that 3.5 bushels of wheat furnish 141 pounds of flour, and 141 pounds of flour furnish 183.2 pounds of bread. How much flour and how much bread will a hundred pounds of wheat make?

192. A man receives a salary of $1500 a year. He estimates his expenses as follows: rent, $28 per month; groceries, $9 per month; provisions, $17 per month. He places the cost of fuel and light at $95 for the year; that of clothing, at $200; and all other items, at $300. If his estimates are correct, how much money will he have left at the end of the year?

193. A owes B $360. To pay the debt he leases B a house at a rent of $24 a month. How many months can B occupy the house before the debt is cancelled?

194. A company of 16 men and 15 women dine together. The cost per each person was $4, but the men pay the whole bill. How much does each man have to pay?

195. A board is 15 inches wide at one end and 9 inches at the other. What is its average width?

196. Below are the prices per pound of certain commodities in Massachusetts for the years mentioned, as given in the Report of the Massachusetts Bureau of Statistics of Labor for 1884. Find to two decimal places the purchasing power of one dollar in pounds of each commodity for each year named.

		Price per pound in the year.			
No	*Article.*	1860.	1872.	1878.	1883.
1.	Flour, superfine,	$0.039	$0.055	$0.044	$0.041
2.	Corn meal,	0.023	0.018	0.020	0.027
3.	Rice,	0.075	0.113	0.093	0.085
4.	Tea, Oolong,	0.548	0.690	0.603	0.539
5.	Sugar, granulated,	0.103	0.120	0.100	0.095
6.	Beef, for roasting,	0.110	0.190	0.145	0.169
7.	Pork, salt,	0.110	0.110	0.098	0.118
8.	Butter,	0.218	0.393	0.253	0.302

197. The log-book of a steamer recorded the following distances in miles made by the steamer for 5 successive days: 316, 344, 278, 214, 363. What was the average rate for the 5 days?

198. The lowest price of bar iron in 1882 was $56 per ton. In 1852 the lowest price was $34 per ton. How much more money would 20,000 tons of bar iron cost in 1882 than in 1852?

199. A fruit-seller sold 24 dozen oranges at 25 cents per dozen, 36 dozen at the rate of 2 dozen for 25 cents, and 15 dozen at 40 cents per dozen. What did he receive for them all, and what was the average price per dozen?

200. A father, dying, left $15,200 to each of his children. One of them dies, and his part was then divided among the survivors, thereby increasing their portions to the amount of $19,000. How many children did the man have, and how much money did he leave?

The following illustrations of the conditions of the laboring classes in Europe are taken from the first annual report of the Commissioner of Labor, Washington, D.C. Find for each case the annual surplus or deficit.

201. ITALIAN STONE-CUTTER.

Outlay.		*Income.*	
Rent	$24.00	Earnings of father	$250.00
Bread	106.85	Earnings of son	83.30
Coffee	18.15	Earnings of girl	40.00
Milk	33.85	Earnings of boy	52.00
Macaroni	36.50	Total income	
Vegetables, etc.	113.15	Total outlay	
Clothing, etc.	71.20	Surplus or deficit	
Fuel, etc.	19.00		
Total			

202. ITALIAN GLASS-WORKER.

Outlay.		*Income.*	
Rent	$16.00	Earnings of father	$145.25
Bread	62.05	Earnings of sons	146.00
Milk and coffee	47.45	Earnings of mother	90.00
Fish	10.95	Earnings of girl	25.00
Meats	9.36	Total income	
Groceries	142.45	Total outlay	
Clothing	42.00	Surplus or deficit	
Fuel and light	12.00		
Religion, etc.	18.00		
Total			

203. SHOEMAKER, LEEDS, ENGLAND.

Outlay.		*Income.*	
Board (with room)	$149.24	Total earnings	$330.72
Clothing	29.05	Total outlay	
Beer and billiards	43.80	Surplus or deficit	
Incidentals	30.60		

204. COLLIER, LIEGE, BELGIUM.

Outlay.		*Income.*	
Rent	$24.00	Earnings of father	$156.00
Bread	87.60	Earnings of mother	87.00
Meats	18.25	Earnings of daughter	58.00
Coffee, milk, etc.	43.80	Earnings of two children	72.50
Beer and spirits	43.80	Total income	
Groceries	76.65	Total outlay	
Clothing	62.00	Surplus or deficit	
Fuel and light	15.00		
Total			

205. MILL SUPERINTENDENT, HALIFAX, ENGLAND.

Outlay.			
Rent	$62.40	Light	$7.20
Bread	73.00	Fuel	23.40
Meat and fish	89.43	Clothing	76.00
Butter, etc.	65.70	Incidentals	39.25
Fruits	33.80	Total outlay	
Tea and coffee	27.37	Total earnings	719.72
Milk	20.07	Surplus or deficit	
Groceries, etc.	112.00		

206 CARPET-WEAVER, HALIFAX, ENGLAND.

Outlay.			
Rent	$24.96	Fuel and light	$16.50
Bread and flour	49.27	Clothing	37.40
Meats	73.00	Carpet	1.55
Lard, butter, etc.	40.15	Incidentals	23.30
Tea and coffee	18.20	Total outlay	
Milk	19.42	Earnings of father	375.00
Beer and ale	23.73	Earnings of mother	113.36
Groceries	145.65	Total income	
Club dues	1.44	Surplus or deficit	

207. FEMALE WEAVER, SOUTH GERMANY.

Outlay.			
Board and lodging	$67.05	Total outlay	$
Clothing	16.20	Total earnings	124.68
Beer	17.52	Surplus or deficit	
Incidentals	8.90		

208. CARPENTER, COLOGNE, GERMANY.

Outlay.			
Rent	$28.80	Clothing	$36.50
Bread	51.10	Incidentals	20.08
Coffee	13.52	Total outlay	
Milk and eggs	21.84		
Meats	17.47	Earnings of father	268.32
Groceries	72.40	Earnings of mother	31.20
Beer	36.75	Total income	
Fuel and light	15.60	Surplus or deficit	

209. The gold coinage at the Philadelphia Mint in 1884 was as follows: 71 double-eagles, 76,905 eagles, 191,048 half-eagles, 1106 three-dollar pieces, 1993 quarter-eagles, and 6206 dollars. What is the total value of this coinage?

210. Find the total value of the silver coins made at the Philadelphia Mint in 1884 the number of pieces being as follows: 14,070,875 dollars, 5275 half-dollars, 8875 quarter-dollars, 3,366,380 dimes.

211. From the report of the Massachusetts Bureau of Statistics of Labor for 1883 it appears that the average annual income of the working-girls of Boston is $269.07, and the average annual *necessary* expenses, $261.77. At this rate, how long would it take a girl to save $100, supposing that she spends only $4 a year for books, amusements, and other items?

212. How many bushels of potatoes, at $0.65 each, are required to pay for a piano costing $260?

213. The account between farmer A and grocer B for one year was as follows:

A sells B.			*B sells A.*		
60 bushels potatoes,	at	$0.85	4 barrels flour,	at	$6.25
460 quarts milk,	"	0.05	16 gallons molasses,	"	0.67
314 dozen eggs,	"	0.18	200 pounds gran. sugar,	"	0.07
250 pounds butter	"	0.27	80 " brown "	"	0.05
12 barrels apples,	"	1.25	45 " coffee,	"	0.32
2 bushels pears,	"	1.50	14 " tea,	"	0.65

When they settle the account, which has to pay money to the other, and how much?

214. A man has in his pocket-book on Monday morning $96.42. During the six days of the week he spends the following amounts: $5.27, $2.48, $18.05, $0.94, $11.73, $31.16. On counting his money at the end of the week, he finds that he has only $16.50 left. How much has been lost or stolen?

215. A gentleman bought an estate for the round sum of $10,000. If the buildings on the estate are worth $2400, and the estate contains 190 acres, what did he pay per acre for the land?

216. A lady bought 16 yards of cloth at 70 cents per yard. She paid $5 cash, and the rest in butter at 20 cents per pound. How many pounds of butter did she pay?

217. A has $672; B, $1260; C, $1512. They buy horses at the same price, paying for each horse the highest price that will allow each man to invest all his money. How many horses did each man buy?

218. When potatoes are worth $0.77 per bushel, and corn $1.10, how many bushels of corn should a farmer receive in exchange for 50 bushels of potatoes?

Add the following:

219.	220.	221.	222.
$901.45	$787.61	$41,321.04	$458,010.13
2,890.35	5,055.12	275,963.24	1,603,420.76
1,840.30	5,086.12	214,708.67	1,419,033.76
2,768.22	11,999.86	577,546.37	4,293,514.77
3,368.67	13,591.38	620,661.34	4,427,162.22
2,331.03	8,904.12	276,457.29	3,110,104.48
2,266.00	9,924.00	445,831.54	3,997,466.22
808.26	3,329.37	282,046.62	1,200,458.14
1,795.10	5,077.36	173,514.03	1,473,918.65
1,927.86	10,393.16	622,552.30	2,672,149.69
3,229.80	6,873.13	205,504.53	2,469,757.38
150.99	7.83	6,436.83	118,819.19
1,983.80	5,240.53	205,923.97	1,562,165.38
3,758.46	10,470.24	474,325.40	3,188,873.24
7,649.04	7,081.51	440,820.75	1,848,745.68
4,738.23	14,842.50	836,247.62	4,426,440.60
3,736.65	8,047.49	339,656.31	2,314,563.02
1,106.77	8,824.88	471,416.39	2,014,899.00
2,004.54	7,389.47	522,548.00	1,846,713.28
2,757.10	8,079.61	270,949.80	2,997,528.75
2,328.52	119.69	7,871.97	3,060,991.86
3,012.58	122.58	834,809.76	1,370,265.87
6,082.40	144.77	482,301.33	518,143.59
4,509.44	118.18	671,921.65	137,948.73
6,784.60	98.52	457,991.20	2,187,505.90
3,942.00	107.01	418.79	1,132,088.55

CHAPTER III.

COMMON FRACTIONS.

Find by cancellation the quotients of:

1. $\frac{68 \times 5 \times 4}{10 \times 8}$.

2. $\frac{102 \times 9 \times 8}{3 \times 6 \times 12}$.

3. $\frac{18 \times 3 \times 36}{6 \times 8 \times 9}$.

4. $\frac{1380 \times 20 \times 15}{8 \times 5 \times 30}$.

5. $\frac{212 \times 85 \times 22}{5 \times 11 \times 17 \times 4}$.

6. $\frac{1165 \times 7 \times 12 \times 4}{14 \times 6 \times 20}$.

7. $\frac{72 \times 9 \times 1799}{6 \times 27 \times 514}$.

8. $\frac{212 \times 133 \times 28}{38 \times 14 \times 14}$.

9. $\frac{270 \times 48 \times 16}{64 \times 45 \times 36}$.

10. $\frac{4350 \times 48 \times 9}{12 \times 4 \times 54}$.

11. $\frac{14 \times 16 \times 5}{20 \times 2 \times 7}$.

12. $\frac{18 \times 3 \times 6}{9 \times 60}$

13. $\frac{42 \times 4 \times 3 \times 1}{6 \times 5 \times 8}$.

14. $\frac{300 \times 6 \times 32}{4 \times 12 \times 16}$.

15. $\frac{90 \times 24 \times 9}{8 \times 18 \times 3}$.

16. $\frac{12 \times 720 \times 64}{16 \times 48 \times 4}$.

17. $\frac{14 \times 2 \times 3 \times 20}{8 \times 9 \times 5}$

18. $\frac{6 \times 24 \times 56}{4 \times 7 \times 16}$

19. $\frac{135 \times 3 \times 41}{5 \times 45 \times 246}$.

20. $\frac{32 \times 32 \times 203 \times 68}{406 \times 34 \times 8}$.

Reduce to whole or mixed numbers:

21. $\frac{36}{9}$. 26. $\frac{100}{81}$. 31. $\frac{2008}{35}$. 36. $\frac{4521}{71}$.

22. $\frac{41}{8}$. 27. $\frac{856}{118}$. 32. $\frac{1000}{27}$. 37. $\frac{4196}{196}$.

23. $\frac{168}{14}$. 28. $\frac{2000}{43}$. 33. $\frac{2500}{81}$. 38. $\frac{7658}{195}$.

24. $\frac{289}{17}$. 29. $\frac{3197}{28}$. 34. $\frac{2000}{78}$. 39. $\frac{865}{72}$.

25. $\frac{886}{19}$. 30. $\frac{4300}{47}$. 35. $\frac{6000}{188}$. 40. $\frac{8864}{171}$.

Reduce to improper fractions:

41. $13\frac{1}{7}$. 46. $15\frac{16}{17}$. 51. $924\frac{17}{18}$. 56. $13\frac{207}{809}$.

42. $28\frac{3}{11}$. 47. $90\frac{17}{50}$. 52. $89\frac{88}{89}$. 57. $8\frac{256}{387}$.

43. $10\frac{5}{9}$. 48. $79\frac{23}{70}$. 53. $3\frac{16}{118}$. 58. $83\frac{82}{85}$.

44. $5\frac{187}{211}$. 49. $231\frac{1}{86}$. 54. $23\frac{112}{881}$. 59. $156\frac{19}{185}$.

45. $8\frac{13}{14}$. 50. $329\frac{13}{15}$. 55. $79\frac{11}{15}$. 60. $15\frac{196}{309}$.

Reduce:

61. 8, 12, 13, 19, 20 to fractions with denominator 12.

62. 5, 11, 14, 17, 24 to fractions with denominator 15.

63. 6, 8, 14, 13, 25 to fractions with denominator 16.

64. $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$ to fractions with denominator 24.

65. $\frac{2}{5}$, $\frac{3}{10}$, $\frac{4}{15}$, $\frac{7}{20}$, $\frac{1}{2}$ to fractions with denominator 60.

66. $\frac{2}{3}$, $\frac{5}{6}$, $\frac{5}{12}$, $\frac{5}{6}$, $\frac{7}{18}$ to fractions with denominator 36.

67. $\frac{2}{3}$, $5\frac{4}{9}$, $3\frac{5}{6}$, $4\frac{1}{2}$, $6\frac{1}{18}$ to fractions with denominator 18.

68. $3\frac{1}{3}$, $4\frac{4}{5}$, $3\frac{3}{10}$, $4\frac{4}{15}$, $6\frac{7}{30}$ to fractions with denominator 30.

69. $4\frac{3}{4}$, $3\frac{5}{8}$, $4\frac{4}{5}$, $3\frac{1}{20}$, $7\frac{7}{10}$ to fractions with denominator 40.

70. 9 to fractions with denominators 4, 8, 7.

71. 33 to fractions with denominators 3, 5, 8.

72. 29 to fractions with denominators 11, 13, 20.

73. 37 to fractions with denominators 12, 14, 15.

Reduce to lowest terms by the method of factoring:

74. $\frac{24}{36}$.
75. $\frac{48}{84}$.
76. $\frac{96}{100}$.
77. $\frac{63}{81}$.
78. $\frac{72}{108}$.
79. $\frac{324}{486}$.
80. $\frac{288}{720}$.
81. $\frac{480}{720}$.
82. $\frac{208}{884}$.
83. $\frac{410}{880}$.
84. $\frac{98}{112}$.
85. $\frac{68}{144}$.
86. $\frac{216}{408}$.
87. $\frac{210}{805}$.
88. $\frac{240}{880}$.
89. $\frac{256}{768}$.
90. $\frac{195}{650}$.
91. $\frac{144}{180}$.
92. $\frac{455}{715}$.
93. $\frac{870}{957}$.
94. $\frac{588}{696}$.
95. $\frac{143}{169}$.
96. $\frac{270}{420}$.
97. $\frac{135}{945}$.
98. $\frac{574}{1050}$.
99. $\frac{48}{60}$.
100. $\frac{256}{614}$.
101. $\frac{126}{189}$.
102. $\frac{406}{435}$.
103. $\frac{221}{234}$.
104. $\frac{324}{342}$.
105. $\frac{221}{247}$.

Reduce to lowest terms by the method of the G.C.M.:

106. $\frac{2639}{3393}$.
107. $\frac{1391}{2675}$.
108. $\frac{1152}{2016}$.
109. $\frac{1001}{1287}$.
110. $\frac{2424}{2727}$.
111. $\frac{2211}{2814}$.
112. $\frac{3584}{4096}$.
113. $\frac{1485}{1722}$.
114. $\frac{812}{3045}$.
115. $\frac{999}{3552}$.
116. $\frac{1972}{9889}$.
117. $\frac{1517}{3700}$.
118. $\frac{1782}{3664}$.
119. $\frac{1584}{5940}$.
120. $\frac{7182}{8046}$.
121. $\frac{5928}{9168}$.
122. $\frac{4968}{5904}$.
123. $\frac{1261}{1818}$.
124. $\frac{6488}{8088}$.
125. $\frac{4285}{7315}$.
126. $\frac{2176}{3264}$.
127. $\frac{756}{2176}$.
128. $\frac{2418}{2607}$.
129. $\frac{897}{1587}$.
130. $\frac{165023}{294456}$.
131. $\frac{102132}{113116}$.
132. $\frac{118880}{180088}$.
133. $\frac{322377}{408110}$.
134. $\frac{389271}{504490}$.
135. $\frac{157423}{546484}$.
136. $\frac{50091}{188887}$.
137. $\frac{272844}{698856}$.

Reduce to simple fractions:

138. $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{4}{5}$.
139. $\frac{3}{5}$ of $\frac{5}{6}$ of $\frac{16}{25}$.
140. $\frac{3}{5}$ of $\frac{26}{27}$ of $\frac{5}{13}$.
141. $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{11}{15}$.
142. $\frac{7}{9}$ of $\frac{3}{4}$ of $8\frac{1}{2}$.
143. $\frac{2}{3}$ of $\frac{11}{12}$ of $\frac{7}{9}$ of $4\frac{1}{2}$.
144. $\frac{3}{5}$ of $2\frac{1}{4}$ of $\frac{3}{7}$ of $5\frac{1}{2}$.
145. $\frac{9}{35}$ of $\frac{3}{5}$ of $4\frac{11}{12}$ of $3\frac{3}{8}$.
146. $\frac{2}{3}$ of $\frac{7}{13}$ of $\frac{18}{19}$ of $3\frac{1}{2}$ of $\frac{18}{13}$.
147. $\frac{13}{17}$ of $\frac{19}{260}$ of $4\frac{1}{4}$ of $\frac{20}{361}$.
148. $\frac{3}{4}$ of $5\frac{1}{2}$ of $\frac{2}{33}$ of $\frac{16}{27}$ of 5.
149. $\frac{22}{49}$ of $16\frac{3}{5}$ of $\frac{3}{25}$ of $70\frac{1}{12}$.
150. $\frac{1}{2}$ of $\frac{4}{17}$ of $\frac{3}{33}$ of $8\frac{1}{2}$ of $8\frac{1}{4}$.
151. $\frac{1}{3}$ of $\frac{1}{9}$ of $\frac{1}{81}$ of 9.
152. $\frac{2}{11}$ of 19 of $4\frac{1}{4}$ of $\frac{11}{17}$.
153. $\frac{3}{17}$ of 7 of $7\frac{1}{12}$ of $\frac{69}{91}$.

Find the product of:

154. $\frac{3}{4} \times \frac{5}{6}$.
155. $\frac{3}{7} \times \frac{7}{11}$.
156. $\frac{5}{8} \times \frac{4}{11}$.
157. $\frac{3}{7} \times \frac{14}{27}$.
158. $\frac{11}{18} \times \frac{24}{27}$.
159. $\frac{3}{8} \times \frac{32}{33}$.
160. $\frac{4}{15} \times \frac{45}{64}$.
161. $\frac{18}{19} \times \frac{76}{81}$.
162. $\frac{3}{4} \times 5\frac{3}{4}$.
163. $\frac{4}{5} \times 7\frac{2}{3}$.
164. $\frac{3}{7} \times 16\frac{1}{7}$.
165. $\frac{2}{5} \times 18\frac{1}{5}$.
166. $1\frac{3}{11} \times \frac{11}{15}$.
167. $2\frac{9}{11} \times \frac{4}{7}$.
168. $\frac{5}{8} \times 6\frac{4}{7}$.
169. $\frac{3}{11} \times 7\frac{1}{7}$.
170. $9\frac{1}{7} \times 8\frac{3}{64}$.
171. $7\frac{2}{13} \times \frac{209}{217}$.
172. $19\frac{1}{2} \times 16\frac{112}{196}$.
173. $23\frac{1}{2} \times 3\frac{11}{47}$.
174. $17\frac{3}{4} \times \frac{189}{142}$.
175. $\frac{1260}{1869} \times \frac{111}{342}$.
176. $4\frac{1}{11} \times 17\frac{1}{29}$.
177. $9\frac{1}{4} \times 7\frac{1}{12}$.
178. $\frac{1}{2} \times 2\frac{2}{3} \times \frac{3}{4}$.
179. $\frac{1}{4} \times 3\frac{1}{2} \times \frac{7}{8}$.
180. $3\frac{3}{4} \times \frac{16}{29} \times \frac{15}{32}$.
181. $2\frac{1}{4} \times \frac{1}{8} \times 3\frac{5}{9}$.
182. $3\frac{1}{11} \times \frac{1}{17} \times 5\frac{1}{2}$.
183. $\frac{3}{5} \times \frac{10}{33} \times 8\frac{1}{4}$.
184. $6\frac{3}{4} \times \frac{8}{27} \times 6\frac{2}{9}$.
185. $\frac{4}{5} \times \frac{5}{7} \times 6\frac{3}{4}$.
186. $\frac{8}{11} \times \frac{3}{7} \times 4\frac{1}{2}$.
187. $7\frac{1}{4} \times \frac{2}{5} \times \frac{11}{29}$.

Find the quotient of:

188. $\frac{3}{4} \div \frac{5}{6}$.
189. $\frac{4}{5} \div \frac{3}{5}$.
190. $\frac{1}{2} \div \frac{3}{4}$.
191. $\frac{7}{9} \div \frac{11}{18}$.
192. $\frac{14}{81} \div \frac{16}{63}$.
193. $\frac{17}{19} \div \frac{34}{38}$.
194. $\frac{11}{12} \div \frac{33}{24}$.
195. $\frac{15}{17} \div \frac{10}{51}$.
196. $\frac{4}{18} \div \frac{5}{126}$.
197. $\frac{17}{91} \div \frac{34}{1638}$.
198. $\frac{10}{21} \div \frac{18}{42}$.
199. $\frac{33}{27} \div \frac{21}{84}$.
200. $5\frac{3}{4} \div \frac{11}{18}$.
201. $7\frac{1}{2} \div \frac{15}{19}$.
202. $3\frac{3}{4} \div \frac{7}{8}$.
203. $6\frac{1}{2} \div \frac{13}{14}$.
204. $19\frac{3}{8} \div 81\frac{1}{2}$.
205. $17\frac{3}{11} \div \frac{33}{39}$.
206. $4\frac{2}{3} \div 5\frac{1}{4}$.
207. $5\frac{2}{9} \div 11\frac{3}{4}$.
208. $2\frac{17}{19} \div 7\frac{6}{7}$.
209. $3\frac{11}{12} \div 9\frac{2}{3}$.
210. $14\frac{2}{3} \div 4\frac{8}{9}$.
211. $7\frac{3}{4} \div 2\frac{1}{8}$.
212. $\frac{81}{32} \div \frac{3}{4}$ of $10\frac{1}{8}$.
213. $\frac{161}{162} \div \frac{7}{9}$ of $25\frac{7}{8}$.
214. $\frac{61}{55} \div \frac{2}{5}$ of $12\frac{3}{4}$.
215. $\frac{12}{44} \div \frac{6}{7}$ of $3\frac{1}{6}$.
216. $3\frac{3}{8} \div \frac{22}{56}$ of $7\frac{1}{2}$.
217. $\frac{1}{4}$ of $\frac{14}{15} \div \frac{7}{26}$.
218. $\frac{1}{6}$ of $2\frac{3}{4} \div \frac{7}{5}$.
219. $\frac{8}{7}$ of $1\frac{7}{16} \div \frac{27}{48}$ of $\frac{53}{81}$.
220. $\frac{4}{7}$ of $\frac{28}{30} \div \frac{8}{7\frac{1}{8}}$ of 4.
221. $\frac{9}{10}$ of $\frac{111}{112} \div \frac{3}{4}$ of $1\frac{1}{11}$.

Change to equivalent fractions with least common denominator:

222. $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}$.

223. $\frac{2}{3}, \frac{3}{4}, \frac{5}{6}$.

224. $\frac{2}{3}, \frac{3}{4}, \frac{5}{6}, \frac{7}{12}$.

225. $\frac{1}{3}, \frac{1}{4}, \frac{5}{6}, \frac{8}{9}$.

226. $\frac{4}{5}, \frac{8}{9}, \frac{11}{12}, \frac{13}{15}$.

227. $\frac{5}{6}, \frac{5}{18}, \frac{13}{24}, \frac{19}{30}$.

228. $\frac{7}{8}, \frac{17}{24}, \frac{19}{32}, \frac{11}{48}$.

229. $\frac{2}{3}, \frac{5}{6}, \frac{7}{12}, \frac{15}{16}$.

230. $\frac{2}{7}, \frac{3}{14}, \frac{5}{18}, \frac{7}{6}, \frac{2}{21}$.

231. $\frac{3}{8}, \frac{3}{4}, \frac{3}{16}, \frac{3}{64}, \frac{3}{256}$.

232. $\frac{3}{5}, \frac{7}{15}, \frac{2}{9}, \frac{11}{24}, \frac{7}{8}, \frac{17}{45}$.

233. $\frac{2}{3}, \frac{3}{4}, \frac{5}{7}, \frac{7}{12}, \frac{13}{18}, \frac{4}{27}$.

Arrange in order of magnitude:

234. $\frac{1}{8}, \frac{2}{15}, \frac{1}{7}$.

235. $\frac{4}{5}, \frac{24}{25}, \frac{5}{6}$.

236. $\frac{3}{5}, \frac{11}{15}, \frac{7}{10}$.

237. $\frac{3}{22}, \frac{1}{7}, \frac{2}{15}$.

238. $\frac{2}{11}, \frac{5}{33}, \frac{13}{16}$.

239. $\frac{5}{6}, \frac{7}{9}, \frac{13}{18}$.

240. $\frac{3}{5}, \frac{5}{6}, \frac{9}{10}$.

241. $\frac{1}{18}, \frac{2}{27}, \frac{3}{40}$.

242. $\frac{8}{9}, \frac{17}{18}, \frac{44}{45}$.

243. $\frac{11}{12}, \frac{9}{10}, \frac{14}{15}$.

244. $\frac{2}{3}, \frac{11}{15}, \frac{7}{12}$.

245. $\frac{3}{7}, \frac{4}{9}, \frac{9}{19}$.

Express in the simplest form the value of:

246. $\frac{1}{2}+\frac{1}{3}+\frac{1}{4}$.

247. $\frac{5}{6}+\frac{7}{8}+\frac{5}{9}$.

248. $\frac{3}{4}+\frac{7}{8}+\frac{9}{10}$.

249. $\frac{3}{11}+\frac{7}{9}+\frac{3}{5}$.

250. $\frac{6}{7}+\frac{8}{9}+\frac{4}{63}$.

251. $\frac{3}{5}+\frac{4}{9}+\frac{17}{30}$.

252. $\frac{2}{3}+\frac{3}{4}+\frac{5}{8}$.

253. $\frac{7}{9}+\frac{5}{7}+\frac{2}{21}$.

254. $\frac{3}{7}+\frac{2}{49}+\frac{3}{14}+\frac{8}{21}$.

255. $\frac{11}{12}+\frac{3}{4}+\frac{7}{48}+\frac{11}{72}$.

256. $\frac{5}{8}+\frac{7}{9}+\frac{19}{36}+\frac{11}{144}$.

257. $\frac{13}{21}+\frac{3}{49}+\frac{16}{35}+\frac{11}{63}$.

258. $\frac{14}{15}+\frac{5}{9}+\frac{13}{27}+\frac{19}{20}$.

259. $\frac{13}{14}+\frac{15}{27}+\frac{1}{2}+\frac{9}{18}$.

260. $\frac{11}{12}+\frac{8}{9}+\frac{11}{15}+\frac{1}{2}$.

261. $\frac{13}{18}+\frac{8}{15}+\frac{11}{20}+\frac{13}{30}$.

262. $3\frac{3}{8}+1\frac{1}{4}+2\frac{1}{3}$.

263. $5\frac{1}{14}+5\frac{3}{5}+2\frac{1}{7}$.

264. $7\frac{1}{12}+6\frac{3}{4}+10\frac{5}{7}$.

265. $4\frac{3}{4}+2\frac{1}{8}+3\frac{1}{3}$.

266. $1\frac{5}{18}+5\frac{1}{15}+2\frac{14}{45}$.

267. $6\frac{1}{2}+7\frac{3}{8}+8\frac{3}{4}+9\frac{5}{6}$.

268. $3\frac{3}{8}+7\frac{1}{6}+8\frac{1}{4}+9\frac{7}{8}$.

269. $7\frac{5}{6}+8\frac{3}{4}+5\frac{15}{16}+7\frac{11}{12}$.

270. $5\frac{1}{2}+6\frac{3}{8}+7\frac{11}{24}+9\frac{17}{48}$.

271. $9\frac{3}{4}+10\frac{5}{7}+11\frac{3}{8}+5\frac{17}{42}$.

Find the value of :

272. $18 - \frac{4}{5}$.
273. $10 - \frac{6}{7}$.
274. $9 - \frac{4}{11}$.
275. $11 - \frac{9}{18}$.
276. $8 - 2\frac{2}{25}$.
277. $23 - \frac{28}{29}$.
278. $18 - \frac{18}{19}$.
279. $6 - \frac{17}{21}$.
280. $5 - \frac{11}{81}$.
281. $19 - \frac{31}{37}$.
282. $\frac{3}{8} - \frac{1}{2}$.
283. $\frac{4}{5} - \frac{3}{4}$.
284. $\frac{3}{4} - \frac{5}{9}$.
285. $\frac{11}{12} - \frac{7}{10}$.
286. $\frac{5}{11} - \frac{3}{7}$.
287. $\frac{11}{12} - \frac{10}{11}$.
288. $\frac{29}{56} - \frac{3}{14}$.
289. $\frac{11}{17} - \frac{7}{15}$.
290. $\frac{3}{9} - \frac{4}{5}$.
291. $\frac{16}{19} - \frac{13}{16}$.
292. $\frac{3}{4} - \frac{15}{64}$.
293. $\frac{14}{15} - \frac{41}{50}$.
294. $\frac{13}{14} - \frac{19}{21}$.
295. $\frac{11}{21} - \frac{17}{42}$.
296. $\frac{77}{100} - \frac{3}{50}$.
297. $\frac{1}{37} - \frac{3}{111}$.
298. $\frac{5}{6} - \frac{5}{8}$.
299. $\frac{7}{9} - \frac{8}{21}$.
300. $\frac{13}{42} - \frac{3}{28}$.
301. $\frac{24}{36} - \frac{8}{21}$.
302. $3\frac{1}{2} - 2\frac{1}{4}$.
303. $7\frac{1}{8} - 5\frac{1}{6}$.
304. $6\frac{4}{7} - 3\frac{3}{4}$.
305. $7\frac{4}{5} - 3\frac{3}{10}$.
306. $8\frac{3}{4} - \frac{2}{5}$.
307. $7\frac{2}{3} - \frac{7}{12}$.
308. $23\frac{11}{12} - 19\frac{17}{48}$.
309. $16\frac{19}{36} - 14\frac{23}{60}$.
310. $18\frac{13}{24} - 17\frac{89}{504}$.
311. $29\frac{11}{112} - 9\frac{13}{168}$.
312. $20\frac{1}{2} - 16\frac{7}{8}$.
313. $16\frac{1}{2} - 13\frac{5}{6}$.
314. $5\frac{1}{15} - 2\frac{14}{45}$.
315. $7\frac{1}{12} - 6\frac{3}{4}$.
316. $2\frac{1}{9} - 1\frac{5}{18}$.
317. $4\frac{5}{8} - 1\frac{3}{9}$.
318. $27\frac{9}{20} - 6\frac{9}{10}$.
319. $16\frac{1}{4} - 9\frac{3}{8}$.

320. $\frac{2}{9}$ of $1\frac{35}{4} - \frac{1}{16}$ of $28\frac{1}{2}$.

321. $3\frac{1}{12} + 8\frac{1}{9} - 3\frac{3}{10} - 2\frac{5}{6} + 5\frac{1}{3} + 6\frac{1}{2} - 16\frac{1}{4}$.

322. $\frac{4}{9} \times \frac{3}{11} \times 6\frac{2}{7} \times 9\frac{3}{5} \times 2\frac{1}{2} \times 63$.

323. $6\frac{1}{2} \times 11\frac{3}{7} \times 16\frac{4}{11} \times \frac{2}{13} \times \frac{7}{30} \times \frac{1}{90}$.

324. $\frac{\frac{1}{7}}{8} \times \frac{\frac{5}{7}}{9\frac{1}{2}} \times \frac{7\frac{1}{9}}{\frac{8}{9}} \times \frac{4\frac{3}{4}}{7\frac{3}{14}} \times \frac{\frac{3}{27}}{1\frac{1}{3}}$.

325. $\frac{27}{37\frac{4}{5}} \times \frac{87\frac{2}{9}}{98\frac{1}{8}} \times \frac{\frac{7}{8}}{2\frac{1}{2}} \times \frac{81\frac{5}{11}}{128}$.

326. $\frac{5\frac{4}{5} - 2\frac{1}{8}}{3\frac{3}{4} - \frac{9}{20}} \times \frac{4\frac{1}{2} + 5\frac{19}{25}}{4\frac{1}{20}} \times \frac{2\frac{3}{5} + 1\frac{2}{3}}{7\frac{19}{24} - 2\frac{1}{4}}$.

Express as common fractions in their simplest form:

327. 0.8.
328. 0.125.
329. 0.3125.
330. 0.15625.
331. 0.032.
332. 0.004.
333. 0.0625.
334. 0.7168.
335. 0.0425.
336. 0.46875.
337. 0.00256.
338. 0.000375.

Express in the form of decimal fractions:

339. $\frac{7}{10}$.
340. $\frac{9}{100}$.
341. $\frac{17}{1000}$.
342. $\frac{218}{1000}$.
343. $\frac{88}{1000}$.
344. $\frac{17}{10000}$.
345. $\frac{217}{10000}$.
346. $\frac{3219}{10000}$.
347. $\frac{3}{8}$.
348. $\frac{7}{8}$.
349. $\frac{4}{25}$.
350. $\frac{18}{25}$.
351. $\frac{7}{16}$.
352. $\frac{5}{16}$.
353. $\frac{11}{82}$.
354. $\frac{3}{40}$.
355. $\frac{9}{64}$.
356. $\frac{7}{80}$.
357. $\frac{3}{128}$.
358. $\frac{7}{128}$.
359. $\frac{31}{160}$.
360. $\frac{11}{250}$.
361. $\frac{13}{500}$.
362. $\frac{17}{640}$.
363. $\frac{7}{800}$.
364. $\frac{11}{1600}$.
365. $\frac{81}{820}$.
366. $\frac{183}{625}$.
367. $\frac{329}{800}$.
368. $\frac{233}{256}$.
369. $\frac{1}{512}$.
370. $\frac{511}{512}$.

Express as decimal fractions:

371. $\frac{2}{3}$.
372. $\frac{7}{9}$.
373. $\frac{4}{11}$.
374. $\frac{1}{37}$.
375. $\frac{4}{99}$.
376. $\frac{4}{27}$.
377. $\frac{5}{18}$.
378. $\frac{11}{21}$.
379. $\frac{7}{128}$.
380. $\frac{4}{909}$.
381. $\frac{8}{271}$.
382. $\frac{5}{6}$.
383. $\frac{7}{24}$.
384. $\frac{3}{22}$.
385. $\frac{4}{9009}$.
386. $\frac{64}{225}$.
387. $\frac{11}{74}$.
388. $\frac{5}{108}$.
389. $\frac{15}{296}$.
390. $\frac{1}{41}$.

Reduce to common fractions:

391. $0.1\dot{6}$.
392. $0.11\dot{6}$.
393. $0.41\dot{6}$.
394. $0.\dot{2}8\dot{8}$.
395. $0.08\dot{3}$.
396. $0.\dot{0}23\dot{1}$.
397. $0.70\dot{4}\dot{5}$.
398. $0.00\dot{4}\dot{5}$.
399. $0.0\dot{0}5\dot{4}$.
400. $0.0\dot{2}\dot{2}\dot{7}$.
401. $0.00\dot{5}\dot{4}$.
402. $0.091\dot{6}$.
403. $0.\dot{0}243\dot{9}$.
404. $0.\dot{4}28571\dot{4}$.
405. $0.\dot{0}76923$.

MISCELLANEOUS EXERCISES.

(Including subjects treated in the preceding chapters.)

406. What part of 25 is $\frac{5}{8}$?

407. What is $\frac{1}{2}$ of $17\frac{1}{4}$? $\frac{3}{4}$ of $39\frac{1}{7}$?

408. Which is the greater, $\frac{21}{63}$ or $\frac{105}{315}$?

409. What is $\frac{3}{11}$ of 94? 94 is $\frac{3}{11}$ of what number?

410. One-fourth, one-third, and three-sevenths of a number added together make 60. What is the number?

411. In France 1225 wolves were killed in 1882, for which the government paid $29,000. What price was paid per head?

412. What fractions are equal to $\frac{3}{8}$, and have for numerators the numbers 6, 51, 33, 39, 48?

413. What is $\frac{5}{12}$ of 70? 70 is $\frac{5}{12}$ of what number?

414. If $\frac{5}{16}$ of a ship is worth $27,000, what is the whole ship worth?

415. If a girl knits $\frac{3}{5}$ of a stocking per day, how long will she take to knit 45 pairs of stockings?

416. Two horses together cost $575. What is the cost of each, if one of them costs $\frac{2}{3}$ as much as the other?

417. Elsie gave $\$\frac{3}{8}$ per yard for 9 yards of gingham, and $\$2\frac{1}{4}$ for lining and trimming. If she had bought her dress ready-made, it would have cost $8.00. What did she save by making it herself?

418. Simplify $\dfrac{4\frac{1}{17}}{6\frac{1}{19}} \times \frac{170}{399} \div \dfrac{12\frac{2}{3}}{7\frac{7}{9}}$.

419. What is the value of 9 boxes of raisins, each containing $27\frac{1}{2}$ pounds, at 18 cents per pound?

420. A tailor, after cutting $8\frac{3}{8}$ yards from a piece of cloth, found that there were $17\frac{3}{8}$ yards left. What was the entire length of the piece?

421. 68 is $(\frac{3}{8} + \frac{5}{4})$ of what number?

422. For hemming linen handkerchiefs, $2\frac{1}{8}$ cents a dozen is paid. When work is good, a girl hems 75 dozen a day. How much does she earn in a week?

423. A workman gets \$3.25 a day, and spends on the average \$2.10. How much will he save in a year of 365 days, counting out 52 Sundays and 4 holidays?

424. Jane has \$12.50, and Susan has \$0.50. What part of Jane's money is Susan's money?

425. If $3\frac{3}{4}$ yards of cloth are required to make a shirt, how many shirts can be made from a piece of $56\frac{1}{4}$ yards?

426. A dry-goods dealer bought 520 yards of cloth at \$1.75 per yard, and sold $\frac{3}{5}$ of it at \$2 per yard. For how much per yard must he sell the remainder in order to make a clear profit of \$250 by the transaction?

427. Divide 5.4306 by 18, and 0.50025 by 29, and add the quotients.

428. How many pairs of trousers, each pair requiring $2\frac{3}{8}$ yards, can be made from a piece of doeskin containing $33\frac{1}{4}$ yards?

429. A grocer bought a hogshead of sugar weighing 744 pounds at $7\frac{1}{8}$ cents per pound, and sold it at $7\frac{1}{2}$ cents per pound. What was his profit?

430. If $3\frac{1}{2}$ yards of cloth are required to make a shirt, how many shirts can be made from 12 pieces, each measuring $47\frac{1}{4}$ yards?

431. What is the value of 7 pieces of cloth, each containing $34\frac{3}{4}$ yards, at \$2.82 per yard?

432. If a boy drops 5 cents in a money-box every day, how much money will he find in it at the end of one year?

433. A farmer was offered \$300 for the apples in his orchard, but preferred to gather them himself. He sold 164 barrels of baldwins at \$1.50 each, 29 barrels of russets at \$1.75 each, and 300 bushels of cider apples at 15 cents a bushel. Calling his labor worth \$50, did he gain or lose by declining the offer, and how much?

434. I sold $\frac{2}{3}$ of a lot of land, and then $\frac{3}{7}$ of what remained. After the second sale there remained $13\frac{1}{3}$ acres. How much land was there to begin with?

435. A locomotive passes over $\frac{7}{12}$ of a route in $3\frac{1}{2}$ hours. In what time will it pass over the entire route? also in what time $\frac{2}{5}$? $\frac{7}{8}$? $\frac{9}{14}$?

436. A workman spends $\frac{1}{3}$ of his income in food, $\frac{1}{8}$ in clothing and lodging, $\frac{1}{10}$ in other expenses, and saves at the end of the year \$318. What was his income?

437. Simplify $\frac{5}{6}-\frac{1}{8}+\frac{5}{24}-\frac{3}{16}-\frac{2}{3}$.

438. Two men are $21\frac{3}{4}$ miles apart; when they meet, one has travelled 5 miles more than the other. How far has each travelled?

439. A boy being asked to find the value of $8\frac{4}{15}+2\frac{7}{9}+3\frac{3}{5}+4\frac{2}{3}$, gave as his answer 18. How great an error did he make?

440. Simplify $\frac{3}{8}-\frac{1}{3}+\frac{7}{24}-\frac{5}{16}+\frac{1}{6}$.

441. Find the value of $\left(1-\frac{4}{6}\frac{2}{9}\frac{6}{7}+\frac{2\frac{1}{2}}{8\frac{1}{2}}\right)\div\frac{3\frac{1}{2}}{5\frac{1}{8}}$.

442. A man bought a cargo of potatoes. After selling $\frac{1}{3}$ of them to one party, $\frac{1}{4}$ to another, and $\frac{1}{6}$ to a third, he had 220 bushels left. How many bushels were there in the cargo?

443. The metre is equal to $3\frac{28}{100}$ feet, very nearly. Express 1 foot as a fraction of a metre.

444. A lady wishing to purchase a piano-cover finds it will require $2\frac{5}{8}$ yards of plush at $\$3\frac{1}{2}$ per yard, the same quantity of lining-flannel at $\$\frac{7}{8}$ per yard, $1\frac{1}{4}$ yards of satin at $\$1\frac{1}{2}$ per yard, $1\frac{1}{8}$ yards of fringe at $\$1\frac{1}{4}$ per yard. The cost of making will be $\$5$. Find the cost of the piano-cover.

445. Mr. Gay sold 86 barrels of baldwin apples for $\$1\frac{7}{8}$ per barrel, 24 barrels of porters at $\$2\frac{1}{8}$ per barrel, and 69 barrels of greenings at $\$1.90$ per barrel. He bought a horse for $\$125$, and spent the remainder for cows at $\$54$ each. How many cows did he get, and how much money had he left?

446. Excursion tickets from Boston to Fabyan's and return cost $\$7\frac{3}{4}$. Board at Fabyan's is $\$3\frac{1}{2}$ per day. To the summit of Mt. Washington, $\$3.00$; to Profile House and Flume, $\$3.00$. What will it cost Mrs. Smith to take these excursions, if she remain at Fabyan's one week?

447. Simplify $\dfrac{\frac{1}{6} \text{ of } 1\frac{13}{16} + 1\frac{1}{6} \text{ of } 6\frac{1}{4} - 1\frac{1}{3} \text{ of } 5\frac{1}{8}}{\frac{1}{6} \text{ of } 2\frac{5}{6} \text{ of } 5\frac{3}{8}}$.

448. A mason built $6\frac{1}{2}$ yards of wall on Monday, $4\frac{5}{8}$ yards on Tuesday, $4\frac{3}{8}$ yards on Wednesday, and $7\frac{3}{8}$ yards on Thursday. How much has he earned in this time, if he is paid $\$0.80$ per yard?

449. Seven cars carried respectively $24\frac{1}{2}$, $18\frac{3}{8}$, $15\frac{6}{8}$, 28, $17\frac{8}{10}$, $32\frac{1}{16}$, $27\frac{8}{12}$ tons of coal. Required the average number of tons carried by each car.

450. Simplify $\frac{87}{88} \times \frac{51}{111} \times \frac{152}{187} \times \frac{188}{171}$.

451. Which is the greater, $\frac{17}{33}$ or $\frac{23}{209}$, and what is the difference between them?

452. Divide the difference between 200,000 and 200,000,000 by 666.

453. Reduce the following fractions to decimals, and then add the results: $\frac{7}{60}$, $\frac{1}{840000}$, $\frac{8}{7}$.

454. Reduce $0.8\dot{7} - 0.2\dot{5}\dot{9} - 0.5\dot{6}$ to a common fraction.

455. If Mr. Jones can plant a certain field in 10 days, but with the assistance of his son can do it in 6 days, how long would it take his son alone to plant the whole field?

456. One gas-jet burns $\frac{3}{5}$ as much as a second, and this burns $\frac{1}{4}$ as much again as a third. How much gas will the first burn while the third burns 1000 cubic feet?

457. A farmer bought a barrel of flour for $7.50, a plough for $12, and 36 pounds of sugar at $7\frac{1}{2}$ cents a pound. How many bushels of potatoes at 60 cents a bushel will pay the bill?

458. Find the total product of each principal crop produced in Ohio, in 1880, from the following data:

		No. of acres.	*Average yield per acre.*
Indian corn,	bushels,	3,198,400	37.5
Wheat,	"	2,845,170	17.5
Rye,	"	29,600	14.7
Oats,	"	911,400	28
Barley,	"	54,030	26.3
Potatoes,	"	124,400	85
Tobacco,	pounds,	35,489	1083
Hay,	tons,	1,782,581	1.24

459. A liberty pole is divided into 4 parts. The first part is $\frac{1}{8}$ of the whole, the second is $\frac{1}{4}$, the third is $\frac{2}{7}$, and the fourth is 11 feet long. What is the entire length of the pole?

460. A furniture dealer bought 140 hair mattresses at \$18.15 each. He wishes to sell them so as to make on the whole number \$180. He has already sold $\frac{5}{7}$ of them at \$18.50 each. How much apiece must he get for the others?

461. Two-thirds of the wood in a large pile have been sold, at \$7 per cord, for \$2940. How many cords remain, and what is the value of the wood remaining?

462. The diameter of the moon is $\frac{3}{11}$ that of the earth. The diameter of the sun is 110 times that of the earth. What fraction of the sun's diameter is that of the moon.

463. Simplify $\frac{\frac{3}{11}\times 9\frac{3}{15}\times 3\frac{1}{7}\times 9\frac{1}{10}}{\frac{4}{17}\times 3\frac{9}{19}\times 12\frac{1}{7}\times 2\frac{10}{33}\times \frac{7}{20}}$.

464. How many pound, half-pound, and quarter-pound packages, of each an equal number, can be made from a chest of tea containing $89\frac{1}{4}$ pounds?

465. A man owning $\frac{3}{14}$ of an estate, sold $\frac{5}{56}$ of his share for \$120$\frac{5}{8}$. What is the value at the same rate of $\frac{3}{80}$ of the whole estate?

466. What is the value of $\frac{1}{11}$ of $\frac{1}{12}$ of a vessel, if a person who owns $\frac{3}{11}$ of it sell $\frac{1}{9}$ of $\frac{7}{8}$ of his share for \$350?

467. If gunpowder is composed of 33 parts of nitre, 7 of charcoal, and 5 of sulphur; how many pounds of each will be required to make 30 pounds of powder?

468. If a silver rupee in Calcutta is worth \$$1\frac{2}{25}$, what must you pay in American money for a sandal wood fan valued at 3 rupees?

469. Find the L.C.M. of 18, 24, 28, 30, 56, 70, and the G.C.M. of 184,851 and 256,496.

470. Find the L.C.M. of 12, 15, 22, 40, 55, 72, and the G.C.M. of 215,441 and 860,343.

471. Simplify $10\frac{1}{2} - 4\frac{6}{7} - 6\frac{3}{14} + 7\frac{5}{8} + 8\frac{2}{3} - 6\frac{23}{42}$.

472. A man owns $\frac{7}{64}$ of a ship. If he sells $\frac{1}{8}$ of his share, what fraction of the whole will he still have?

473. Three persons divide the cost of a musical entertainment in such a manner that the first pays $\frac{1}{3}$ of the whole, the second $\frac{6}{5}$ of what the first pays, and the third pays the remainder, which is \$50. What is the amount of the bill?

474. The rates of the express and mail trains on a railway are 40 and 28 miles respectively. What time is saved by taking the former for a journey of 192 miles?

475. Simplify $2\frac{1}{2} - 3\frac{1}{4} - 4\frac{1}{8} - 5\frac{1}{6} + 252\frac{1}{12}$.

476. If $\frac{2}{5}$ of $1\frac{1}{4}$ of an estate be worth \$300, what will $\frac{2\frac{1}{2}}{\frac{5}{14}}$ of it bring at the same rate?

477. A farmer put $\frac{3}{5}$ of his corn into one bin, and the rest into another. He sold $\frac{2}{3}$ of what was in the first bin and $\frac{2}{5}$ of what was in the other. The rest he kept for his own use. How much did he keep, the whole quantity being 480 bushels?

478. If $\frac{2}{11}$ of a piece of work be done in 25 days, how much will be done in $11\frac{2}{3}$ days?

479. A cistern holding 6000 gallons is supplied with water by 2 pipes. One of them will admit 100 gallons in $1\frac{1}{2}$ hours, the other, 200 gallons in $4\frac{1}{2}$ hours. If both pipes are opened when the cistern is empty, in how many hours will it be filled?

480. I bought of a merchant tailor $5\frac{3}{4}$ yards of broadcloth for the sum of $\$20.12\frac{1}{2}$. On measuring it, I found that there were only $4\frac{7}{8}$ yards. How much ought the tailor to pay me back?

481. Find the value of

$$11.0071-0.30103+19-14.09-0.0982+6.774.$$

482. A boy spends $\frac{1}{4}$ of his money for a dictionary, $\frac{1}{5}$ for a geography, and $\frac{1}{8}$ for a pair of skates. These purchases amount to $\$1\frac{3}{20}$ more than $\frac{1}{2}$ of all the money he has. What sum is paid for each article?

483. If a young man spend in four months as much as he earns in three, how much can he lay by annually, on the supposition that he earns $\$250\frac{1}{2}$ every six months?

484. A merchant tailor has 16 dozen shirts made from cloth costing 12 cents per yard. The bosoms cost him 50 cents each, and he pays for making, 35 cents apiece. It requires $8\frac{1}{2}$ yards of cloth for 3 shirts. How much will he gain if he sells the shirts at $\$20$ per dozen?

485. A piece of work must be finished in 36 days, and 15 men are set to do it, working 9 hours a day; but after 24 days it is found that only three-fifths of the work is done. If 3 additional men be then put on, how many hours a day will they all have to labor in order to finish the work in time?

486. What must be added to $\frac{3}{7}$ of $\frac{5}{8}$ in order that the sum may be equal to $\frac{9}{10}$ of $3\frac{3}{4}$?

487. A can do a piece of work in 7 hours, and B can do it in 8 hours. If they work at it for an hour alternately, A beginning, in how many hours will the work be finished?

488. The sum of two numbers is $774\frac{3}{4}$, and their difference $178\frac{1}{2}$. What is their product?

489. George can gather 5 bushels of cranberries in three days; Henry, 7 bushels in nine days; Rufus, 11 bushels in twelve days. In how many days can they together gather 121 bushels?

490. If $\frac{5}{8}$ of a roll of carpeting is worth $78.50, what is the whole roll worth?

491. Two men undertake to do a piece of work for $14. One could do it alone in 6 days, the other in 7 days. With the help of a boy, they finish it in 3 days. How should the money be divided?

492. What number exceeds the sum of its fourth, fifth, and sixth parts by 161?

493. A farmer bought 7 bullocks for $480, and after keeping them 16 weeks, at a cost of $3.15 per week each, he sold them for $117 each. Did he gain or lose, and how much?

494. What will be the expense of giving to each of 175 poor children a sandwich, a cream-cake, and an orange, the sandwiches being 5 cents each, the cakes 40 cents a dozen, and the oranges 25 cents a dozen?

495. The circulation of the Boston *Herald* for the week of the presidential election, ending Nov. 9, 1884, was as follows: Monday, 110,620; Tuesday, 180,487; Wednesday, 302,030; Thursday, 198,642; Friday, 182,788; Saturday, 160,400; Sunday, 104,960. Find the total circulation for the week, the average for the week, and the total value at a cent and a half a copy.

496. From a tank full of water $\frac{2}{3}$ of the water was withdrawn. Then 35 gallons were added, when the tank was exactly half full. What is the capacity of the tank?

497. Mrs. Snow, having \$50, wished to purchase a dress. She bought 24 yards of silk at \$$1\frac{1}{8}$ per yard, $1\frac{1}{2}$ yards of silesia at 18 cents per yard, $5\frac{1}{2}$ yards of cambric at 8 cents per yard, 2 spools of silk at $12\frac{1}{2}$ cents each, 1 spool of twist for 5 cents, $1\frac{1}{2}$ dozen buttons at 42 cents per dozen, and $\frac{7}{8}$ of a yard of velvet at \$2 per yard; she paid \$15 for making the dress. How much money had she left?

498. What is the freight on 5600 bushels of oats, of 32 pounds each, from Chicago to New York, at \$0.60 per 100 pounds?

499. What is the value of 15 pieces of broadcloth, each piece containing $44\frac{4}{5}$ yards, worth \$$3\frac{1}{8}$ per yard?

500. A trader bought wheat at \$1.25 per bushel, and sold it at \$1.17 per bushel. How much did he lose on every dollar he paid?

501. How many bushels of potatoes at \$$\frac{7}{8}$ per bushel will pay for $12\frac{1}{2}$ bushels of wheat at \$1.20 per bushel?

502. A grocer bought a hogshead of molasses containing 128 gallons at \$0.64 per gallon. He paid \$2.08 for cartage and lost 16 gallons by leakage. At what price per gallon must the remainder be sold to gain $\frac{1}{6}$ of the entire cost?

503. From a piece of calico containing $35\frac{7}{8}$ yards there have been sold at different times $12\frac{3}{4}$ yards, $2\frac{1}{2}$ yards, $2\frac{3}{16}$ yards, and $8\frac{5}{8}$ yards. How many yards remain?

504. A father and his son undertake a piece of work which they can do in 15 days by working together. They work together 6 days, and the son then finishes the work in 30 days. How many days would it take them each to do the piece of work?

505. Find the G.C.M. and L.C.M. of 471, 1256, and 1727.

506. Find the value of $\frac{34 \times \frac{5}{8}}{1\frac{7}{10} \times \frac{7}{1000}}$.

507. Reduce to decimals $\frac{4}{13}$, $\frac{51}{187}$, and $\frac{3\frac{1}{7} - 2\frac{1}{2}}{0.4 \times 0.5}$.

508. Simplify $10 - 7.889 + 13.0052 - 2.99372$; and also simplify $10 - 13.00\dot{5}\dot{2} + 7.8\dot{8}\dot{9} + 2.99\dot{3}\dot{7}\dot{2}$.

509. Find the value, correct to seven decimal places, of $17.824 - 11.6\dot{3}17\dot{2} + 9.8\dot{8}\dot{3} - 1.16\dot{8}5714\dot{2} + 12.\dot{3}$.

510. If 5 pounds of copper are melted with $4\frac{1}{2}$ pounds of tin, how much copper will there be for each pound of tin? How much copper will there be in 1 pound of the alloy?

511. If gun metal is composed of $90\frac{1}{2}$ parts of copper to $9\frac{1}{2}$ parts of tin by weight, how much tin and how much copper are there in 1 pound of gun metal?

512. How many minutes will it take a pipe, supplying water at the rate of $2\frac{5}{6}$ gallons per minute, to fill a cistern holding $62\frac{3}{8}$ gallons?

513. Simplify $\frac{7}{11}$ of $\frac{\frac{19}{81} - \frac{9}{49} - \frac{1}{27}}{\frac{1}{2} + \frac{1}{14} - \frac{5}{9}} \times (3\frac{1}{6} + \frac{1}{2} - 2\frac{1}{10})$.

514. A gas chandelier in a public hall consumed 2700 cubic feet of gas in 86 hours. The cost of the gas was \$6.75. Find (i.) the price of the gas per 1000 feet, (ii.) the cost of the light per hour, (iii.) the number of cubic feet of gas consumed in $5\frac{1}{2}$ hours.

515. One man does $\frac{3}{8}$ of a piece of work, and another man does $\frac{2}{7}$ of it. What fraction of the work remains to be done?

516. Three masons working together built a wall in 12 days. The first, working alone, could have built it in 32 days, and the second in 36 days. If \$96 is paid for building the wall, how much should each mason receive?

517. If 19 pounds of silver are alloyed with 31 pounds of copper, how many pounds of each of these metals are there in 191 pounds of the alloy?

518. Three brothers buy a farm, the first taking $\frac{4}{10}$ of it, the second $\frac{1}{3}$, and the third the remainder. The third paid \$1722 for his part, which measured 42 acres. What did each of the others receive, and what did he pay?

519. Bell-metal consists of 4 parts of copper to 1 part of tin. What will a bell weighing 12,400 pounds cost, if the copper costs 19 cents per pound, and the tin $22\frac{1}{2}$ cents per pound, and the cost of making, etc. is \$500?

520. A tailor cuts $9\frac{2}{14}$ yards of cloth from a piece measuring $44\frac{4}{14}$ yards. How many vests, each requiring $1\frac{1}{7}$ yards, can he make with the remainder?

521. The sum of $\frac{1}{3}$ and $\frac{1}{4}$ of a number is $16\frac{1}{12}$. What is the number?

522. Simplify $\dfrac{0.203 \times 0.0004 \times 16}{0.008 \times 0.0029}$.

523. Find the total annual cost of a house, of which the rent is \$864, the gas-rate is $\frac{1}{54}$ of the rent, the water-rate is $\frac{2}{3}$ of the gas-rate, and the expense of clearing the sidewalks from snow is $\frac{3}{8}$ of the water-rate.

524. Find the value of $\dfrac{2\frac{3}{4} \times 7\frac{7}{11}}{\frac{1}{2} \times \frac{3}{4} \times 18\frac{2}{3}}$.

525. How many tons of ore must be taken from a mine that, after a loss of $\frac{17}{40}$ in roasting, and $\frac{8}{19}$ of the residue in smelting, there shall remain 506 tons of pure metal?

526. A laborer has to spend $45\frac{1}{2}$ cents per week on bread when it is at $6\frac{1}{2}$ cents a loaf. If the price rise to 7 cents a loaf, how much less bread must his family eat in a week, that it may cost him the same as before?

527. A freight train leaves a station, and travels at the rate of 10 miles an hour; after 4 hours another train follows from the same station, travelling $16\frac{2}{3}$ miles an hour. How many miles must the second train travel before it comes up with the first?

528. A farmer has his sheep in two pastures; the number in one is three-fifths the number in the other. If there are 480 in the whole flock, how many are there in each pasture?

529. Simplify $\dfrac{0.304 \times 0.002 \times 1.8}{0.0009 \times 0.038}$.

530. A gentleman, by his will, gave $\frac{1}{4}$ of his property to his eldest son, $\frac{2}{7}$ to the next, $\frac{3}{11}$ to the third, and the rest to the youngest. The portion of the youngest was \$47,400. What was the value of the entire property?

531. A can do a piece of work in $3\frac{1}{2}$ hours, B in $3\frac{1}{7}$ hours, and C in $4\frac{1}{3}$ hours. In how many hours can they do it, working together? If \$3 is paid for doing the work, what is each man's share?

532. The amount of starch in potatoes is $\frac{1}{10}$ of their weight, but the amount that can usually be extracted is only $\frac{2}{15}$. How many pounds weight of starch can be obtained from 100 pounds of potatoes, and how much is left in the potatoes after the process of extracting is ended?

533. A man walking 18 miles finds that the distance he has walked in 1 hour 40 minutes is $\frac{5}{7}$ of the remaining distance. Find his rate of walking.

534. A grocer mixes equal weights of raw Java coffee, costing 24 cents per pound, and Rio coffee, costing $14\frac{1}{2}$ cents per pound. The loss in weight by roasting and grinding is $\frac{1}{8}$. At what price per pound must he retail the mixture in order to make a gross profit of 2 cents per pound?

535. Green coffee when roasted loses $\frac{1}{6}$ of its weight. A dealer buys raw coffee at $22\frac{1}{2}$ cents per pound, and sells it roasted at 30 cents per pound. What will be his gain or loss in filling an order for 1000 pounds of roasted coffee, if the cost of roasting be \$ 2.25?

536. When flour is worth \$ 7.35 per barrel (196 pounds), what ought to be the price of half-pound loaves of bread, assuming that 4 pounds of flour make 5 pounds of bread, and allowing to the baker a profit just equal to the cost of the flour?

537. If grapes yield $\frac{3}{5}$ of their bulk of wine, and wine yields $\frac{1}{10}$ of its bulk of alcohol, and a quart of alcohol weighs $1\frac{5}{6}$ pounds, how many pounds of alcohol can be made from 100 bushels of grapes?

538. A farmer planted $\frac{2}{3}$ of a field with corn, $\frac{1}{4}$ with potatoes, and the rest, amounting to $2\frac{1}{2}$ acres, with oats. He harvested 660 bushels of corn, 1080 bushels of potatoes, and 105 bushels of oats. What was the yield of each in bushels per acre?

539. If an iron bar, when heated from 0° to 1° of the centigrade thermometer, expands by $\frac{1}{79\frac{1}{100}}$ of its length, what will be the length in feet at 30° of a bar whose length at 0° is $10\frac{5}{6}$ feet?

CHAPTER IV.

COMMON MEASURES.

TABLES.

I. Length.

12 inches (in.)	= 1 foot (ft.).
3 feet	= 1 yard (yd.).
5½ yards, or 16½ feet	= 1 rod (rd.).
320 rods, 1760 yards, or 5280 feet	= 1 mile (mi.).

Measures sometimes used for Special Purposes.

1 line = $\frac{1}{12}$ in.	1 cubit = 18 in.	1 fathom = 6 ft.
1 palm = 3 in.	1 pace = 2½ ft.	1 furlong = ⅛ mi.
1 hand = 4 in.	1 chain = 4 rds.	1 knot = 6086 ft.
1 span = 9 in.	1 link = $\frac{1}{100}$ chain.	1 league = 3 knots

II. Surface.

144 square inches (sq. in.)	= 1 square foot (sq. ft.).
9 square feet	= 1 square yard (sq. yd.).
30¼ square yards	= 1 square rod (sq. rd.).
160 square rods	= 1 acre (A.).
640 acres	= 1 square mile (sq. mi.).

Measures sometimes used for Special Purposes.

1 rood	= 40 sq. rds.
1 square of flooring or roofing	= 100 sq. ft.
1 section of government land	= 1 mile square.
1 township of land	= 36 sq. miles.

III. Volume.

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.).
27 cubic feet = 1 cubic yard (cu. yd.).
128 cubic feet = 1 cord.

Measures in use for Special Purposes.

1 cord foot = $\frac{1}{8}$ of a cord = 16 cu. ft.
1 board foot = a board 1 foot square and 1 in. thick.

IV. Capacity.

Dry Measure.	*Liquid Measure.*
2 pints (pt.) = 1 quart (qt.).	4 gills (gi.) = 1 pint (pt.).
8 quarts = 1 peck (pk.).	2 pints = 1 quart (qt.).
4 pecks = 1 bushel (bu.).	4 quarts = 1 gallon (gal.).

Apothecaries' Measure,

Used for compounding medicines, is as follows:

60 minims (℥) = 1 dram (℥ lx).
8 drams = 1 fluid ounce (fl. dr. viii).
16 fluid ounces = 1 liquid pint (fl. oz. xvi).

Comparison of Units of Volume and Capacity.

1 bushel = 2150.42 cu. in. = 1.25 cu. ft. nearly.
1 cubic foot = 0.8 of a bushel, nearly.
1 gallon = 231 cu. in. = $\frac{231}{1728}$ of a cu. ft., nearly.
1 cubic foot = $7\frac{1}{2}$ gallons, nearly.
23 dry quarts = 27 liquid quarts, nearly.
1 bushel, *heaped* measure = 5 pecks, nearly.
1 British imperial bushel = 1.032 United States bushels.
1 British imperial gallon = 1.2 United States gallons.
1 British quarter = 8 imperial bushels.
1 cubic foot of water weighs $62\frac{1}{2}$ pounds, nearly.
1 gallon of water weighs $8\frac{1}{3}$ pounds nearly.

V. Weight.

Troy Weight.

24 grains (gr.) = 1 pennyweight (dwt.)
20 pennyweights = 1 ounce (oz.)
12 ounces = 1 pound (lb.).

Avoirdupois Weight.

16 drams (dr.) = 1 ounce (oz.).
16 ounces = 1 pound (lb.).
100 pounds = 1 hundredweight (cwt.).
2000 pounds = 1 ton (t.).

The long ton is still used in the United States Custom Houses and in wholesale transactions in iron and coal.

112 pounds avoirdupois = 1 long hundredweight.
2240 pounds avoirdupois = 1 long ton.
1 pound avoirdupois = 7000 Troy grains.

Apothecaries' Weight.

20 grains Troy = 1 scruple (℈). 8 drams = 1 ounce (℥).
3 scruples = 1 dram (ʒ). 12 ounces = 1 pound.

VI. Time.

60 seconds (sec.) = 1 minute (min.).
60 minutes = 1 hour (hr.).
24 hours = 1 day (dy.).
7 days = 1 week (wk.).
365 days = 1 common year (yr.).
366 days = 1 leap-year.

The day of this table is the *mean solar day*, or *average* interval between two successive passages of the sun across the meridian.

Average length of the year = 365 dys. 5 hrs. 48 min. 50 sec., nearly.

Thirty days have September, April, June, and November;
February has *twenty-eight* alone; all the rest have *thirty-one;*
But leap-year, coming once in four, gives February *one day more.*

Every year divisible by 4 is a leap-year, except those centennial years in which the *number* of centuries is *not* divisible by 4; thus, 1888 and 2000 are leap-years, but 1887 and 1900 are not leap-years.

VII. Angular Measure.

60 seconds (″) = 1 minute (′).
60 minutes = 1 degree (°).
90 degrees = 1 right angle.
360 degrees = 1 revolution.

The circumference of a circle is divided into 360 equal parts, called degrees; each degree into 60 minutes; each minute into 60 seconds. The larger the circle, the greater the length of 1 degree.

1 degree of the earth's equator = 60 knots = 69.16 miles.

A quadrant = ¼ part of a circumference.

VIII. Money.

United States Money.

10 mills = 1 cent (ct.).
10 cents = 1 dime.
10 dimes = 1 dollar ($).
10 dollars = 1 eagle.

English Money.

4 farthings (far.) = 1 penny (*d.*).
12 pence = 1 shilling (*s.*).
20 shillings = 1 pound (£ or *l.*).
21 shillings = 1 guinea.

1 sovereign = 1 pound, 1 crown = 5 *s.*, 1 florin = 2 *s.*

Comparison of Units of Money.

English Money:	£1 = $4.8665;	$1 = 4.1099 *s.*	
Canadian Money:	100 cents	= 1 dollar.	
French Money:	100 centimes	= 1 franc (fr.)	= $0.193.
German Money:	100 pfennigs	= 1 mark (M.)	= $0.238.
Austrian Money:	100 kreutzers	= 1 florin (fl.)	= $0.393.
Russian Money:	100 kopecks	= 1 rouble (rb.)	= $0.636.
Spanish Money:	100 centimes	= 1 peseta	= $0.193.
Portuguese Money:	1000 reis	= 1 milreis	= $1.080.
Brazilian Money:	1000 reis	= 1 milreis	= $0.546.
Dutch Money:		1 florin	= $0.402.
Italian Money:		1 lira	= $0.193.
Mexican Money:		1 dollar	= $0.864.
Chilian Money:		1 peso	= $0.912.

IX. Miscellaneous Measures.

1. *Capacity.*

The *barrel*, *hogshead*, *pipe*, and *tun* have no fixed values. The barrel varies from 28 gals. to 42 gals.; the hogshead, from 54 gals to 63 gals.; and the pipe, from 110 gals. to 140 gals.

40 ft. of round timber, or 50 ft. of hewn timber = 1 ton, or load

1 ton of a vessel's tonnage = 100 cu. ft.
1 ton of a vessel's cargo = 40 cu. ft.

A perch of masonry is usually reckoned at 25 cu. ft.

The dimensions of common brick are $8 \times 4 \times 2$ in
The dimensions of Maine brick are $7\frac{1}{2} \times 3\frac{3}{8} \times 2\frac{3}{8}$ in.
The dimensions of North River brick are $8 \times 3\frac{1}{2} \times 2\frac{1}{4}$ in
The dimensions of Philadelphia brick are $8\frac{1}{4} \times 4\frac{1}{8} \times 2\frac{3}{8}$ in.
The dimensions of Milwaukee brick are $8\frac{1}{2} \times 4\frac{1}{8} \times 2\frac{3}{8}$ in.

2. *Weight.*

The weight of a bushel of grain is fixed by law in many of the States. The weights given below are those adopted in business:

1 bu. of wheat	= 60 lbs.	1 bu. of potatoes	= 60 lbs
1 bu. of corn or rye	= 56 lbs.	1 barrel of flour	= 196 lbs.
1 bu. of corn or rye meal	= 50 lbs.	1 barrel of beef or pork	= 200 lbs.
		1 cask of lime	= 240 lbs.
1 bu. of oats	= 32 lbs.	1 quintal of fish	= 100 lbs.
1 bu. of barley	= 48 lbs.	1 stone of iron or lead	= 14 lbs
1 bu. of timothy seed	= 45 lbs.	1 pig of iron or lead	= 300 lbs

400 cu. ft. of well-settled English hay = 1 ton.
500 cu. ft. of well-settled meadow hay = 1 ton.
550 cu. ft. of clover hay = 1 ton.

3. *Number.*

12 units = 1 dozen (doz.).
12 dozen = 1 gross (gro.).
12 gross = 1 great gross.
20 units = 1 score.

4. *Paper.*

24 sheets = 1 quire.
20 quires = 1 ream.
2 reams = 1 bundle
5 bundles = 1 bale

Reduce·

1. 20 rds. to feet.
2. 4 mi. to chains.
3. 30 leagues to feet.
4. 6 A. to square feet.
5. 800 cds. to cubic feet.
6. 126 gals. to pints.
7. 1 wk. to seconds.
8. 1 leap-year to hours.
9. 30° to seconds.
10. £27 to pence.
11. 864 in. to yards.
12. 31,680 ft. to miles.
13. 1280 chains to miles.
14. 1920 pts. to bushels.
15. 640 gi. to gallons.
16. 60,000 pts. to gallons.
17. 256,000 oz. to tons.
18. 720 min. to hours.
19. 1461 dys. to years.
20. 10,560 *d.* to pounds.
21. Reduce 3 mi. 230 rds. 3 yds. to feet.
22. Reduce 29 A. 139 sq. rds. to square rods.
23. Reduce 43 cu. yds. to cubic inches.
24. Reduce 24 bu. 2 qts. to pints.
25. Reduce 5 gals. 1 pt. to gills.
26. Reduce 119 oz. 17 dwt. to grains.
27. Reduce 17 t. 640 lbs. to ounces.
28. Reduce 1,000,000 in. to higher units.
29. Reduce 14,080 A. to square miles.
30. Reduce 261,360 sq. ft. to acres.
31. Reduce 3780 cu. ft. to cubic yards.
32. Reduce 7680 cu. ft. to cords.
33. Reduce 17,280 gr. to Troy pounds.
34. Reduce 55,360 oz. to higher units.
35. Reduce 139,292 min. to higher units.
36. Reduce 162,000″ to degrees.
37. Reduce 1,950,067 far. to crowns.
38. What cost 6 t. of salt at $1\frac{1}{2}$ cts. per lb.?

39. Reduce 95,040 in. to miles.
40. Reduce 53,250 sq. yds. to acres.
41. Reduce 1,353,024 cu. in. to cubic yards.
42. Reduce 256 cu. yds. to cords.
43. Reduce 736 pts. to gallons.
44. Reduce 508 dry qts. to higher units.
45. Reduce 65,136 gr. to higher units Troy.
46. Reduce 1,000,000 oz. to tons, etc.
47. Reduce 119,000 gr. Troy to pounds avoirdupois.
48. Reduce 947,291 sec. to higher units.
49. Reduce 17 mi. 305 rds. $3\frac{1}{2}$ yds. to inches.
50. Reduce 33 A. 74 sq. rds. 18 sq. yds. $6\frac{1}{2}$ sq. ft. to sq. ft.
51. Reduce 19 cu. yds. 22 cu. ft. to cubic inches.
52. Reduce 23 lbs. 9 oz. 17 dwt. 21 gr. Troy to grains.
53. Reduce 17 wks. 5 dys. 19 hrs. to minutes.
54. Reduce $\frac{1}{10}$ of a rod to the fraction of a mile.
55. Reduce $3\frac{2}{3}$ yds. to the fraction of a mile.
56. Reduce $\frac{3}{7}$ of a sq. yd. to the fraction of an acre.
57. Reduce $\frac{1}{4}$ of a cu. ft. to the fraction of a cubic yard.
58. Reduce $\frac{1}{7}$ of a gill to the fraction of a gallon.
59. Reduce $\frac{1}{4}$ of a pint to the fraction of a bushel.
60. Reduce $\frac{4}{7}$ of an oz. to the fraction of 2 pounds.
61. Reduce $\frac{1}{10}$ of an hr. to the fraction of a week.
62. Reduce $\frac{1}{2}$ of a sec. to the fraction of a day.
63. What part of an acre is 9000 sq. ft.?
64. What part of a gill is 0.03 of a gallon?
65. What part of 2 hrs. is $2\frac{1}{2}$ min.?
66. How many paces are there in 1 mi.?
67. Reduce $\frac{1}{7}$ of a pint to the fraction of a bushell.

68. Reduce $84\frac{1}{2}$ mi. to inches.

69. Reduce $1\frac{9}{16}$ mi. to feet.

70. Reduce $\frac{5}{6}$ of a mile to rods, etc.

71. Reduce $\frac{1}{40}$ of an acre to square feet.

72. Reduce 0.05 sq. mi. to acres.

73. Reduce $\frac{1}{9}$ cu. yd. to cubic inches.

74. Reduce 0.15 cu. ft. to cubic inches.

75. Reduce $\frac{1}{24}$ of a cord to cubic feet.

76. Reduce $\frac{1}{16}$ of a bushel to pints.

77. Reduce $\frac{1}{12}$ of 9 bu. to quarts.

78. Reduce $\frac{1}{8}$ of a gallon to quarts, etc.

79. Reduce $\frac{1}{7}$ of a ton to lower units.

80. Reduce 0.8125 t. to pounds.

81. Reduce $\frac{2}{3}$ lb. Troy to lower units.

82. Reduce $\frac{1}{4}$ of an hour to seconds.

83. Reduce 0.58 of a year to days.

84. Reduce $\frac{1}{7}$ of 10 ft. to the fraction of a rod.

85. Reduce $\frac{3}{4}$ of a square yard to the fraction of a square rod.

86. Reduce $\frac{1}{2}$ of a cord foot to the fraction of a cord.

87. Reduce $\frac{1}{4}$ of a dry pint to the fraction of $2\frac{1}{2}$ qts.

88. Reduce $\frac{1}{16}$ of a gallon to the fraction of 3 pts.

89. Reduce 4.16 dr. to the decimal of a pound.

90. Reduce $6\frac{1}{7}$ oz. to the fraction of a pound.

91. How many minutes and seconds are there in 0.00213 of a day?

92. Find the number of quart boxes required for 5 bu. 3 pks. 2 qts. of strawberries.

93. Find the value of 40 bu. of beans, at 8 cts. per quart.

94. Reduce 2,914,367 in. to higher units.

95. Reduce 94,249 sq. yds. to acres.

96. Reduce 2,315,520 cu. in. to cubic yards.

97. Reduce 26,347,289 sec. to weeks, etc.

98. Reduce $\frac{3}{17}$ of a mile to rods, etc.

99. Reduce 56.24 rds. to feet.

100. Reduce $2\frac{1}{2}$ A. to square feet.

101. Reduce 0.001 cu. ft. to cubic inches.

102. Reduce $\frac{3}{8}$ of 42 gals. to quarts.

103. Reduce $\frac{1}{8}$ of 3 lbs. to ounces.

104. Reduce $\frac{75}{112}$ of a week to lower units.

105. Reduce 0.713 of a day to hours, etc.

106. Reduce 0.25 of a mile to the fraction of 8800 yds.

107. Reduce $\frac{1}{8}$ of a rood to the fraction of 2 A.

108. Reduce $\frac{8}{9}$ of a pound to the fraction of a long hundredweight.

109. Reduce 2 ft. to the fraction of a rod.

110. Reduce 266 rds. 11 ft. to the fraction of a mile.

111. Reduce $\frac{2}{9}$ of $8\frac{3}{4}$ days to the fraction of a week.

112. Reduce 4 cd. ft. to the fraction of $4\frac{1}{2}$ cords.

113. Reduce 3 pts. to the fraction of 4 bu. 2 pks.

114. Reduce $4\frac{1}{2}$ gills to the decimal of a gallon.

115. Reduce 8 oz. to the fraction of a ton.

116. Reduce 5 oz. 17 dwt. 18 gr. to the fraction of a pound Troy.

117. Reduce 3 dys. 10 hrs. 30 min. to the fraction of a week.

118. Reduce 55 min. 37 sec. to the decimal of a day.

119. A manufacturer put up $7\frac{1}{8}$ t. of soda in half-pound packages. How many packages did he put up?

120. In 1 mi. how many chains? In 1 link how many inches?

121. The four sides of a field are found by measurement to be as follows: 2.2 chains, 5.35 chains, 7.76 chains, 6.94 chains. What is the distance around the field in feet?

122. The captain found that the ship was still in 8 fathoms of water. What is this distance in feet?

123. The ship's rate is 4 knots per hour. Reduce this to miles.

124. Reduce 160 leagues to miles.

125. We are told in the Bible that the height of the giant Goliath was "six cubits and a span." What was his height in feet and inches?

126. How many acres are there in a township?

127. In 1155 dry quarts how many liquid quarts?

128. In 10,652 liquid quarts how many dry quarts?

129. Find the capacity in gallons of a tank containing 400 cubic feet.

130. How many bushels will the same tank hold?

131. How many gallons will fill a bushel measure even full?

132. Reduce 33,000 imperial bushels to U. S. bushels.

133. Reduce 1 lb. Troy to the fraction of a pound avoirdupois.

134. Reduce 4320 lbs. avoirdupois to pounds Troy.

135. Reduce $\frac{4}{7}$ of a pound avoirdupois to the fraction of a pound Troy.

136. In 8 lbs. avoirdupois how many drams apothecaries' weight?

137. How many cubic feet capacity has a vessel of 300 t.?

138. Reduce 16 score to units; 33 gross to units.

Add:

139.					140.		141.		
mi.	rds.	yds.	ft.	in.	A.	sq. rds.	gals.	qts.	pts.
46	98	3	1	6	6	20	9	2	1
20	259	5	2	9	9	26	7	3	0
50	177	4	1	6	2	110	4	1	$1\frac{1}{2}$
37	310	3	2	10	10	82	12	0	$1\frac{1}{4}$
37	212	4	2	9	7	144	15	3	$1\frac{1}{4}$

142. Add: 3 ft. 6 in.; 17 ft. $4\frac{1}{2}$ in.; 4 ft.; 3 ft. $3\frac{3}{4}$ in.; 2 ft. 4 in.; 7 ft. 11 in.; $5\frac{3}{4}$ in.; 1 ft. $2\frac{1}{4}$ in.; 2 ft. $0\frac{3}{4}$ in.

143. Add: 6 bu. 1 pk. 7 qts. 1 pt.; 2 bu. 2 pks. 5 qts. $\frac{1}{2}$ pt.; 19 bu. 3 pks. 0 qts. 1 pt.; 14 bu. 2 pks. 4 qts. $1\frac{1}{2}$ pts.; 10 bu. 1 pk. 3 qts. 1 pt.; 5 bu. 3 pks. 2 qts.

144. Add: 3 wks. 4 dys. 16 hrs. 26 min. 18 sec.; 9 wks. 1 dy. 20 hrs. 44 min. 50 sec.; 7 wks. 6 dys. 2 hrs. 5 min. 30 sec.; 8 wks. 5 dys. 21 hrs. 59 min. 57 sec.

145. Add: 45° 6′ 20″; 30° 45′; 21° 19′ 40″; 90°; 6° 4′ 40″; 7° 9′; 19° 7′ 20″.

146. A stable-keeper bought hay during the winter, in lots weighing as follows: 2 t. 1240 lbs.; 7 t. 600 lbs.; 3 t.; 4 t. 1800 lbs.; 2 t. 200 lbs.; 1 t. 820 lbs. How much hay did he buy all together?

147. How many grains are there in 3 nuggets of gold weighing respectively, 11 oz. 13 dwt. 17 grs.; 15 oz. 14 dwt. 19 grs.; and 17 oz. 9 dwt. 13 grs.?

148. How many feet in $\frac{1}{12}$ of a mile + $\frac{1}{11}$ of a rod + $\frac{1}{6}$ of a yard?

149. Add $1\frac{1}{40}$ A., $5\frac{1}{8}$ sq. rds., $15\frac{1}{6}$ sq. yds., and express the result in square feet.

150. A painter used 2 gals. 3 qts. of oil on one house, and $3\frac{1}{4}$ gals. on another. How much did he use on both houses?

151. Find the difference between 8 ft. and 3 ft. 8 in.

152. Find the difference between 2 A. and 200 sq. rds.

153. Find the difference between 4 cds. and 4 cd. ft.

154. Find the difference between 2 bu. and 5 qts. 1 pt.

155. Find the difference between $4\frac{1}{3}$ cu. yds. and 1152 cu. in.

156. Find the difference between $\frac{1}{2}$ of a bushel and $\frac{1}{4}$ of a peck.

157. Find the difference between $3\frac{3}{16}$ gals. and 3 qts. 1 pt.

158. Find the difference between 8 long tons and 9 short tons.

159. Subtract 19 mi. 311 rds. 4 yds. 1 ft. 6 in. from $35\frac{1}{2}$ miles.

160. From 1 mi. 1706 yds. 3 ft. 3 in. take 175 yds. 2 ft.

161. A gas company laid 18 mi. 144 rds. 9 ft. of pipe, and paid cash for 7 mi. 200 rds. 12 ft. How much remains to be paid for?

162. From 2 A. take 112 sq. rds. 12 sq. yds. 6 sq. ft. 10 sq. in.

163. A field contains $6\frac{1}{4}$ acres. 2 A. 77 sq. rds. of the field is planted with corn, and the remainder with potatoes. How much is planted with potatoes?

164. From a barrel containing 42 gals. of kerosene there were taken 14 gals. 3 qts. 1 pt. How much was left?

165. From 4 lbs. 7 oz. 19 dwt. Troy take 2 lbs. 9 oz. 21 dwt.

166. From 35 wks. 3 dys. 15 hrs. 25 min. take 17 wks. 6 dys. 22 hrs. 39 min., and reduce the remainder to seconds.

167. Take $\frac{13}{24}$ of a foot from $\frac{7}{16}$ of a yard. Give the answer in inches.

168. Take 12.5 rds. from 0.1625 of a mile.

169. Multiply 18 ft. 7 in. by 9.

170. Multiply 4 sq. rds. 6 sq. ft. by 62.

171. Multiply 59 A. 105 sq. rds. by 27.

172. Multiply 696 lbs. 5 oz. by 2311.

173. Multiply 47 miles 150 rds. 3 yds. by 198.

174. Multiply 17 bu. 3 pks. 6 qts. by $8\frac{1}{4}$.

175. Multiply 26 gals. 2 qts. 1 pt. by $12\frac{1}{8}$.

176. Multiply 3 lbs. 5 oz. 6 dwt. 7 grs. by $45\frac{5}{7}$.

177. If a man can mow 2 A. 20 sq. rds. of grass in a day, how many acres can he mow in 3 wks.?

178. If a horse eat 2 bu. 3 pks. 3 qts. of oats in a week, how many bushels will he eat in 12 wks.?

179. How much kerosene oil will a family use in one year, if they use 1 gal. 1 qt. per month from April 1, to October 1, and twice this amount per month during the remainder of the year?

180. How many grains are there in 7 ingots of silver, each weighing 27 oz. 9 dwts.?

181. Multiply 9 dys. 17 hrs. 35 min. 25 sec. by 28.

182. Find the weight of 27 bars of steel, each weighing 101 lbs. 8 oz.

183. Find the value of 11 A. $67\frac{1}{2}$ sq. rds. of land, at $\$850$ per acre.

184. A field is divided into 47 gardens, each containing 25 sq. rds. 16 sq. yds. What is the area of the field?

185. A wealthy landowner wishes to give to 37 poor people of his parish small lots of land, each containing 50 sq. rds. 5 sq. yds. How much land will be required?

186. Multiply 459 lbs. 11 oz. 15 dwt. 23 grs. by 77.

187. If a man take 750 steps of 2 ft. 8 in. each in 5 minutes, what is his rate of walking per hour?

188. Divide 18 mi. 143 rds. $1\frac{1}{2}$ yds. by 35.

189. Divide 39 A. 150 sq. rds. by 45.

190. Divide 84 cds. 100 cu. ft. by 16.

191. Divide 39 A. 73 sq. rds. by $11\frac{5}{8}$.

192. Divide 373 oz. 8 dwt. 3 grs. by 35.

193. Divide 1 t. 1105 lbs. by $67\frac{1}{2}$.

194. Divide 145 wks. 2 dys. 14 hrs. 55 min. by 19.

195. Divide 5616 wks. 2 dys. 23 hrs. 3 min. by 315.

196. How many bottles each holding $1\frac{1}{2}$ pts. can be filled out of a cask of wine containing 114 gals. ?

197. How long will 84 bu. of oats last 7 horses, if each horse eats $\frac{3}{4}$ of a peck a day ?

198. How many barrels each holding 2 bu. 3 pks. will be required to hold 165 bu. of apples ?

199. How many bags each holding 2 bu. 1 pk. 3 qts. are required to hold 234 bu. 1 pk. 4 qts. of corn ?

200. How many panes of glass each containing 24 sq. in. are required for a house with 33 windows, each measuring 4 sq. yds. ?

201. How many times is 195 yds. 1 ft. 8 in. contained in 1 mi. ?

202. A mason laid 25 rds. $2\frac{1}{2}$ yds. of stone wall in 20 days. How much did he lay per day ?

203. How many books each $1\frac{3}{4}$ in. thick can be put on a shelf 2 ft. $5\frac{3}{4}$ in. long ?

204. A field containing 5 A. 75 sq. rds. is divided into 25 equal garden lots. What is the area of each lot ?

205. How many tablespoons each weighing 2 oz. 17 dwt. 12 grs. can be made from 155 oz. 5 dwt. of silver ?

206. A fruit-dealer wishes to pack 585 lbs. of raisins in boxes each holding 7 lbs. 8 oz. How many boxes will he need ?

Find the period in years from the following dates to Jan. 1, 1885:

207. The discovery of America, 1492.

208. The Reformation, 1517.

209. Landing of the Pilgrims, 1620.

210. Battle of Waterloo, 1815.

211. The time of Abraham, 2000 B.C.

212. Founding of Rome, 754 B.C.

213. Battle of Marathon, 480 B.C.

214. Death of Cæsar, 44 B.C.

At what age did the following men die?

215. Luther, born Nov. 10, 1483; died Feb. 18, 1546.

216. Goethe, born Aug. 28, 1749; died March 22, 1832.

217. Newton, born Dec. 25, 1642; died March 20, 1727.

218. Washington, born Feb. 22, 1732; died Dec. 14, 1799.

219. Franklin, born Jan. 17, 1706; died April 17, 1790.

220. Shakespeare, b. April 23, 1564; d. April 23, 1616.

221. Daniel Webster, b. Jan. 18, 1782; d. Oct. 24, 1852.

222. H.W. Longfellow, b. Feb. 27, 1807; d. Mar. 24, 1882.

Find the dates when the following men died:

223. Thomas Carlyle, born Dec. 4, 1795; age, 85 yrs. 2 mos. 1 dy.

224. Napoleon, b. Aug. 15, 1769; age, 51 yrs. 8 mos. 20 dys.

225. Sir W. Scott, b. Aug. 15, 1771; age, 61 yrs. 1 mo. 6 dys.

Find the dates when the following men were born:

226. Copernicus, d. Nov. 6, 1632; age, 70 yrs. 3 mos. 5 dys.

227. Galileo, d. Jan. 28, 1642; age, 77 yrs. 11 mos. 9 dys.

228. Byron, d. April 19, 1824; age, 36 yrs. 2 mos. 27 dys.

How many days between:

229. Mar. 21, 1885 and Sept. 23, 1885?

230. Jan. 11, 1883 and Mar. 25, 1883?

231. Feb. 2, 1884 and May 22, 1884?

232. Feb. 2, 1885 and May 22, 1885?

233. Nov. 9, 1880 and Mar. 13, 1881?

234. Aug. 22, 1883 and July 21, 1885?

235. If the summer vacation begin June 27 and lasts 12 wks., on what date will school begin again?

236. On April 4, a man gave his note for 3 mos.; on what date does the note become due, 3 days of grace being included?

237. On Monday a man set out on a journey. He was gone 100 dys. On what day of the week did he return?

238. In what respect do the first day and the twenty-ninth day of the month agree?

239. Jan. 1, 1859, fell on Saturday. What day of the week was Jan. 1, 1860? Jan. 1, 1861? What was the first year after 1859 in which Jan. 1 again fell on Saturday?

240. Jan. 1, 1876, occurred on Saturday. What day of the week was July 4, and what day was Christmas of the same year?

241. If Aug. 8 is on Monday, what day of the week will Nov. 1 be?

242. If a leap-year begin on Wednesday, what day of September will be the first Monday of that month?

243. If in a leap-year July 9 is on Friday, on what day of the week did the year begin?

244. How many hours from 5 P.M. June 18, to 9 A.M. Aug. 1?

245. How many minutes from 10.45 A.M. Monday, to 6.35 P.M. Friday?

NOTE. The sun appears to move towards the west at the rate of 15° per hour, or 15′ per min., or 15″ per sec.; hence, **Sun Time** varies at the same rate, and *the more easterly the place, the later the time.*

Standard Time is the sun time of some selected meridian. The meridian selected is

75° west of Greenwich, for Eastern standard time.
90° west of Greenwich, for Central standard time.
105° west of Greenwich, for Mountain standard time.
120° west of Greenwich, for Western standard time.

246. Find the difference in time between Greenwich time and each of the standard times.

247. Find the difference between Eastern standard time and sun time at Boston (71° 4′ W.), New York (74° 1′ W.), and Washington (77° W.).

248. Find the difference between Central standard time and sun time at Cincinnati (84° 39′ W.), Chicago (87° 38′ W.), and St. Louis (90° 15′ W.).

Find the difference of longitude if the difference of sun time is:

249. 7 min. 48 sec.
250. 51 min. 25 sec.
251. 1 hr. 18 min. 12 sec.
252. 10 hr. 13 min. 19 sec.

Find the longitude of a place whose sun time compared with Greenwich time is:

253. 1 hr. 20 min. slow.
254. 2 hrs. 37 min. fast.
255. 46 min. 52 sec. slow.
256. 3 hrs. 9 min. 32 sec. fast.

Find the difference in sun time between:

257. Boston and Washington.
258. New York and Chicago.
259. Boston and London (0° 5′ W.).
260. St. Louis and Rome (12° 27′ E.).

261. How many half-crowns are equivalent to 285 guineas?

262. Add 23 guineas, 37 sovereigns, 55 crowns, 31 florins, 53 sixpences, and 79 pence.

263. A clerk saved from his yearly salary of 150 guineas the sum of £16 1 *s.* 3 *d.* What was his average daily expenditure?

264. Subtract 57½ guineas from £89 12 *s.* 7½ *d.*

265. Subtract 119 half-crowns from 37 half-guineas.

266. Find the amount of a servant's wages for 135 dys. at 10½ *d.* per day.

267. A man takes furnished lodgings in London at 27 *s.* 6 *d.* per week. What rent will he have to pay for the months of April, May, and June?

268. If a man's income be 450 guineas, and his average daily outlay 19 *s.* 7½ *d.*, how much can he save in 1 year?

269. A lady buys 12 yds. of silk at 3 *s.* 6 *d.* per yd.: 8 yds. of flannel at 1 *s.* 8 *d.* per yd.; 6 pairs of stockings at 1 *s.* 9 *d.* per pair; and 3 pairs of gloves at 2 *s.* 6 *d.* per pair. If she gives a five-pound note in payment, how much change ought she to receive?

270. How many dollars are required to pay a debt of £153 19 *s.* 2 *d.*, counting a dollar worth 4 *s.* 2 *d.*?

271. Find the equivalent in English money of $20,000.

272. What is the value in U.S. money of 3 pipes of sherry wine, each containing 130 gals., if they are invoiced at the Custom House at 10 pesetas per gallon?

273. A man changed $1000 to English money, paying $4.84 per pound. After spending £72 17 *s.* 3 *d.*, he changed the remainder to francs, paying 10 *d.* per franc. After spending 1146 fr. he changed the remainder to marks, paying 24 fr. for 19 marks. How many marks did he obtain?

274. How long will it take a man to walk 1 mi. 240 rds. 120 yds. at the rate of $3\frac{1}{2}$ mi. per hour?

275. In a walking-match a man walked $109\frac{1}{3}$ mi. in 24 hrs. What was his average rate per hour?

276. If an express train travels 45 mi. an hour, how many feet does it pass over in 1 sec.?

277. A train travels the distance between two places in 4 hrs. 35 min. at the rate of $16\frac{4}{5}$ mi. per hour. How long would a train going at the rate of $19\frac{1}{4}$ mi. per hour take to travel the same distance?

278. If a man steps 28 in. each step, and takes 117 steps per minute, how long will he be in walking 26 mi.?

279. If the telegraph posts are placed 80 yds. apart, and one is observed to pass the window every 5 sec., how many miles per hour is the train travelling?

280. If a man walk 23 mi. in 6 hrs., 20 mi., what is his rate per hour?

281. A vessel sailed 11,067 mi. between 6 A.M. May 13, and 6 P.M. July 11. What was her average rate per hour?

282. A man wishing to find his rate of walking, observes that he takes 750 steps of 2 ft. 8 in. each in 5 min. What is his rate of walking per hour?

283. A carriage wheel 10 ft. 9 in. in circumference makes 12 revolutions in 10 sec. At what rate per hour is the carriage travelling?

284. The distance between two hills is 9 mi. A cannon was fired on one hill, and persons on the other hill observed that the interval between seeing the flash and hearing the report was $42\frac{1}{2}$ sec. How far did the sound travel in 1 sec.?

285. In what time would a train travelling 31 mi. an hour pass from the earth to the moon, a distance of 237,628 mi.?

Miscellaneous Exercises.

(Including also the subjects of the preceding chapters.)

286. How many quires of paper are there in 64 bales?

287. How many sheets of paper are there in 80 reams?

288. How many reams of paper in 19,200 sheets?

289. How many half-pint bottles can a druggist fill from a demijohn containing 5 gals. of cologne-water?

290. How many short tons in 1000 long tons of coal?

291. How many minutes in the first 3 months of 1888? in the first 3 months of 1889?

292. I bought $\frac{3}{4}$ of an acre of land for $1500, and sold it in lots at 10 cts. per square foot. Find my profit.

293. How many quart boxes will 6 bu. 1 pk. 3 qts. of grapes fill?

294. How many gill bottles can be filled with 4 gals. of rose-water?

295. If a man spend 7 hrs. each day in sleep, how many days will this be in 1 yr.?

296. Add $\frac{13}{21}$ of a month, $\frac{17}{24}$ of a week, $\frac{11}{18}$ of a day, and $\frac{9}{20}$ of an hour.

297. What is the cost of building a railroad 27 mi. long, at $12.50 per yard?

298. How many quart boxes can be filled from a pile of cherries containing 6 bu. 2 pks. 5 qts.?

299. How many pint bottles can be filled from a pipe of wine holding 120 gals.?

300. If you buy 3 pts. of milk a day, how many gallons will you buy in one common year?

301. The length of the civil year is 365 dys. 5 hrs. 48 min. 49.7 sec. Express the length in days and the decimal of a day.

302. The mean interval between a new moon and the next following is 29.530588715 dys. Express this interval in days, hours, minutes, and seconds.

303. A farmer raised 322 bu. 3 pks. of corn from 9 A. of land. What was the yield per acre?

304. A lamp which burns 3 hrs. each evening, burns 1 gal. of kerosene oil in 4 wks. How much does it burn per hour?

305. A man had a barrel of cider containing 42 gals. He sold 6 gals. to one neighbor, 6 qts. to another, and 6 pts. to a third. What is the remainder worth at 5 cents per quart?

306. Farmer Ross raised one year 560 bu. of potatoes. He sold 300 bu. at $0.80 per bushel and peddled the remainder at $0.30 per peck. How much did he receive for his potatoes?

307. From a field containing 27 A. 95 sq. rds. 26 sq. yds. I sold 11 A. 148 sq. rds. 20 sq. yds. How much was left?

308. Subtract $29\frac{1}{11}$ rds. from $\frac{7}{320}$ of a mile. Give the answer in yards.

309. Subtract $\frac{37}{66}$ of a day from $\frac{9}{320}$ of the month of April.

310. A fruit-dealer sold 3 bu. 3 pks. of apples on Monday; 4 bu. 2 pks. 5 qts. on Tuesday; 7 bu. on Wednesday; 1 bu. 1 qt. on Thursday; 5 bu. 3 pks. 6 qts. on Friday; and 8 bu. 1 pk. 7 qts. on Saturday. How many apples did he sell during the week?

311. A manufacturer puts up 4000 doz. of four-ounce packages of yeast-powder every week. How many pounds does he put up?

312. A stationer buys paper at $2.80 per ream, and retails it at 18 cts. per quire. How many reams must he sell in order to make a profit of $1000?

313. How many steps averaging 2 ft. 6 in. each must I take in walking a distance of 11 mi.?

314. How many times will a pendulum vibrate in a week, if it vibrate 5 times in 6 sec.?

315. A milkman sells 93 qts. of milk per day. How many gallons will he sell during the three summer months?

316. If a man steps 3 ft. at a time, and takes 2 steps each second, how far will he walk in 4 hrs.?

317. A coal-dealer bought a cargo of 400 long tons of coal at $5.10 per ton, and retailed it at $5.75 per short ton. What was his profit?

318. From a piece of land containing $1\frac{1}{2}$ A. there were sold 4 lots, each containing 42 sq. rds. 116 sq. ft. What is the remainder worth, at 20 cts. per square foot?

319. A spice-merchant put up 8 t. of ground mustard in cans, each holding 4 oz. The mustard cost him $350 per ton; the cans, half a cent each; and the labor of canning, $0.80 per hundred cans. What will be the profit, if he sells the mustard at 10 cts. per can?

320. I wish to print 6000 copies of a pamphlet of 72 pages, on paper weighing 40 lbs. per ream and costing 8 cts. per pound. Each sheet of the paper makes 32 pages of the pamphlet. How much will the paper for the pamphlet cost?

321. On July 1, Mr. Sawyer paid to the city his annual water-tax of $24. On Nov. 8, he moved to another city. How much money should the city return to him?

322. What is the circumference of a wheel which makes 16,920 revolutions in going 17 mi. 200 rds.?

323. Divide 84 wks. 3 dys. 16 hrs. 35 min. by 3 wks. 4 dys. 17 hrs. 25 min.

324. How many parcels each weighing 2 lbs. 12 oz. can be made up from 1848 lbs.?

325. Divide 203 lbs. 9 oz. 1 dwt. 12 grs. by 36.

326. How many trees can be planted on 5¼ A. of ground, 35 sq. yds. being allowed to each tree?

327. How many vibrations will a pendulum make during the month of December, at the rate of 65 per minute?

328. If a field of 7 A. produce 392 bu. of wheat, how many bushels may be expected from a similar field containing 9 A. 140 sq. rds.?

329. A gold snuff-box weighs 7 oz. 17 dwt. 12 grs. What is its value, at the rate of $20.80 per ounce?

330. A gentleman hires furnished rooms at $6.60 per week. How much will he have to pay for the months of April, May, and June?

331. If 7 horses eat 21 bu. of oats in 16 dys., how long will 99 bu. 3 pks. last them?

332. The four sides of a field measure respectively, 125 yds. 2 ft., 114 yds. 1 ft. 6 in., 80 yds. 2 ft. 3 in., and 137 yds. 1 ft. 9 in. What will it cost to surround the field with wire fence at 36 cts. per yard?

333. How many pounds avoirdupois are equivalent to 55 lbs. Troy?

334. A composition consisting of half a dram of sulphate of iron, 10 grs. of subcarbonate of potash, a dram of myrrh, and half a dram of aloes is to be divided into 30 pills. What will be the weight of each pill?

335. A cask of wine containing 52½ gals. was bottled off into an equal number of quart, pint, and half-pint bottles. How many dozen of each kind were there?

336. At what rate per hour does a man walk who goes 26 mi. 1100 yds. in 7 hrs. and 6 min.?

337. A milkman charges for his milk 7 cts. per quart from Nov. 1 to April 1, and 6 cts. per quart for the rest of the year. If a family use 1 qt. daily from Nov. 1 to July 1, and 3 pts. daily for the rest of the year, find the amount of their milk bill for the year.

338. If A can mow 275 sq. yds. per hour, and B 330, in what time will both together mow a field of 2 A. 150 sq. rds.?

339. My gas-bill for the last 4 mos. of the year was $33.50, and the meter showed a consumption of 16,750 cu. ft. during that time. What was the rate of charge per 1000 cu. ft.?

340. How much land in Boston, at $2.25 per square foot, will $400,000 buy?

341. What must be paid for 6 bu. 2 pks. 6 qts. of timothy seed at $2.24 per bushel?

342. How many times is 3 wks. 19 h. 25 min. 15 sec. contained in 133 wks. 6 dys. 19 h. 5 min. 45 sec.?

343. Take 0.09375 of an acre from 33 sq. rds.

344. Take $\frac{21}{40}$ of 7 A. 120 sq. rds. from $\frac{8}{15}$ of 12 A. 60 sq. rds.

345. Take $\frac{29}{36}$ of a day from $\frac{11}{48}$ of a week.

346. Take $\frac{11}{18}$ of a week from $\frac{9}{20}$ of the month of April.

347. Mr. White's store is 2 mi. 45 rds. 2 yds. from his house. If he walks from his house to his store and back daily (Sundays excepted), how far will he have walked in 1 yr. on this road?

348. What will 23,280 lbs. of wheat cost at 80 cents a bushel?

349. A milliner in the busy seasons can earn $3.50 a day. If the busy seasons are 12 wks. in the spring and 12 wks. in the fall, how much can she earn during them?

350. Sold 28 bu. of rye at $1.10 per bushel, and 57 bu. of oats at 60 cents per bushel. How much did I receive for the rye? for the oats? for both together?

351. Make out a bill for the following goods: 240 bbls. of sugar, at $17.50; 800 lbs. of raisins, at $0.16; 167 bbls. of flour, at $7.25; 95 Webster's Dictionaries, at $6.85; 3,200 bbls. of flour, at $4.45; 375 silver watches, at $14.75; 980 yds. of carpeting, at $0.95; 69 office chairs, at $3.15.

352. Farmer Allen sold to Rice & Co. 3 loads of hay weighing respectively 1850 lbs., 1455 lbs., and 1920 lbs., at $16.80 per ton; and 281 lbs. of pork at $8.25 per cwt. He received in exchange 40 yds. of sheeting at $0.09, $8\frac{1}{2}$ yds. of cloth at $3.50, and the balance in money. How much money did he receive?

353. A reservoir which holds 800 gals. of water receives $75\frac{3}{4}$ gals. per hour from one pipe, $86\frac{2}{3}$ gals. per hour from another pipe, and loses $64\frac{4}{5}$ gals. per hour by a third pipe. If the reservoir be empty, and all three pipes are opened, in what time will the reservoir be filled?

354. How many cords of wood will be required to make 7 t. of charcoal, if $4\frac{1}{2}$ t. of wood make 1 t. of charcoal, and 1 cd. of wood weighs 3500 lbs.?

355. A farm consists of 7 fields measuring as follows: 9 A. 67 sq. rds.; 13 A. 35 sq. rds.; 11 A. 99 sq. rds.; 7 A. 55 sq. rds.; 19 A. 25 sq. rds.; 8 A. 135 sq. rds.; 12 A. 80 sq. rds. Required the area of the farm.

356. A line of railroad is $43\frac{1}{10}$ mi. long. 19 mi. 455 yds. have already been constructed. How much remains to be constructed?

357. A regiment marching $3\frac{1}{2}$ mi. an hour makes 110 steps in a minute. What is the length of the step?

358. A burns kerosene oil, costing 20 cents per gallon, and B burns gas, costing \$2 per thousand cubic feet. A's lamp consumes $\frac{3}{4}$ of a gill of oil per hour, and B's burner consumes 6 cu. ft. of gas per hour. If both use light on the average 3 hours daily, from Oct. 1 to May 1, how much less will A's oil cost than B's gas?

359. The distance between two wickets was marked out for 22 yds.; but the yard measure was $\frac{5}{12}$ of an inch too short. What was the actual distance?

360. How many yards of carpet $\frac{1}{2}$ of a yard wide will cover a floor $27\frac{1}{2}$ ft. by 19 ft.?

361. For carpeting a room $10\frac{2}{3}$ yds. long and $7\frac{1}{3}$ yds. broad \$56.32 are paid. At 54 cents per yard, what is the width of the carpet used?

362. A farmer planted 2 A. 16 sq. rds. of land with potatoes. The yield amounted to 150 bu. per acre. He kept $\frac{2}{3}$ of the potatoes for his own use, and exchanged the rest for meal at the rate of $2\frac{1}{2}$ bu. of potatoes for one bag of meal. How many bags of meal did he get?

363. Find the expense of carpeting a room 15¾ ft. long and 13⅓ ft. broad, with carpet ⅔ of a yard wide, at 54 cents per yard.

364. Find the cost of varnishing the floor of a room 14 ft. 14 in. broad and 15 ft. 6 in. long, at 6 cents per square yard.

365. A lady has 20 lbs. of red currents for making jelly. 7 lbs. of currents yield 5 lbs. of juice, and the weight of the sugar required is ⅘ of the weight of the juice. In boiling down the loss in weight is ⅛. How much sugar is required, and how much jelly will be obtained?

366. What weight of water will a rectangular cistern contain, the length being 4 ft., the breadth 2½ ft., and the depth 3¼ ft; a cubic foot of water weighing 1000 oz.?

367. A block of stone 4 ft. long, 2½ ft. broad, and 1¼ ft. thick, weighs 27 cwt. of 112 lbs. each. Find the weight of 100 cu. in. of the stone.

368. A milliner with $100 purchased 6 yds. of velvet at $4¼ per yard, 10 yds. of ottoman ribbon at $0.46 per dollar per yard, 12 yds. of satin ribbon at ⅝ of a dollar per yard, 8 yds. of black lace at ⅞ of a dollar per yard, 24 yds. of white lace at ¼ of a dollar per yard, 3 doz. felt hats at ¾ of a dollar each, 2 doz. plumes at ⅝ of a dollar each, and 10 bunches of flowers at ⅞ of a dollar per bunch. How much money remained?

369. Samuel picked 7 qts. of berries on Monday, 9 qts. on Tuesday, and 6 qts. on Wednesday. He sold what he picked on Monday and Tuesday for 12 cents per quart, but received only 10½ cents per quart for those picked on Wednesday. He put $1.00 in the savings bank, and bought a hat for $1¼. How many handkerchiefs, at 10 cents each, could he get with the remainder?

370. From a rye-field containing $3\frac{1}{2}$ A. a farmer obtained 52 bu. of rye, and 2 t. 9 cwt. of straw. He sold the rye at \$1.05 per bushel, and the straw at \$13 per ton. How much money per acre did the field yield him?

371. A man walks 18 mi. 2 fur. 26 rds. $3\frac{2}{3}$ yds. in $5\frac{1}{2}$ hrs. In what time will he walk $1\frac{1}{2}$ mi.?

372. A farmer exchanged corn, at \$0.85 per bushel, and rye, at \$1.40 per bushel, for 12 t. of hay, at \$18.50 per ton delivered. If he gives 150 bu. of corn, how many bushels of rye are required to square the account?

373. A farmer exchanged 6 cds. of wood, at \$7.25 per cord, for 3 bbls. of flour, at \$5.75 per barrel, and the rest of the pay in sugar, at $6\frac{3}{4}$ cents per pound. How many pounds of sugar should he receive?

374. What is the freight bill for carrying 87,550 lbs. of beef from St. Louis to New York, at \$0.56 per hundredweight?

375. In Trenton, N. J., there are 23 pottery establishments with an aggregate of 110 kilns, and an annual production of \$4,000,000 worth of goods. What is the average value produced by each pottery? by each kiln?

376. At a printing house, male compositors get 35 cents per 1000 ems, and female compositors, 25 cents. If a male compositor can set 6000 ems in a day, how many ems must a female compositor set in order to earn the same amount of money?

377. What is the value of a chest of tea containing 79 lbs. 10 oz., at $62\frac{1}{2}$ cents per pound?

378. Add together 6 sq. yds. 7 sq. ft. $56\frac{5}{6}$ sq. in., 17 sq. yds. 4 sq. ft. $91\frac{8}{9}$ sq. in., 5 sq. yds. 3 sq. ft. $100\frac{2}{3}$ sq. in., and subtract 20 sq. yds. 7 sq. ft. $140\frac{3}{4}$ sq. in. from the sum.

379. Reduce 7 hrs. 15 min. to the decimal of a day?

When it is 7 A.M. sun time at Paris (2° 20′ E.), what is the time:

380. At Petersburg (30° 19′ E.)?

381. At Calcutta (88° 26′ E.)?

382. At New York (74° W.)?

383. At San Francisco (122° 14′ W.)?

384. How many yards of flannel, at 54 cents per yard, are equal in value to 12 pairs of blankets, $7.56 per pair?

385. Reduce 56 days to the decimal of a year.

386. Two railway trains start at 7 A.M. at opposite ends of a line 640 mi. long. Their average rate is 32 mi. an hour. At what hour will they meet?

387. For transporting a pile of coal from one place to another, 18 laborers were employed with wheelbarrows holding on the average 220 lbs. of coal. After they had made 10 trips, the pile was reduced one-half in size. What was the weight of the pile?

388. How many days and hours are there from March 8, 10 A.M., to Nov. 13, 11 P.M.?

389. How many days and hours are there from 2 A.M., Feb. 3, 1887, to 6 P.M., Dec. 23, 1889?

390. A bicyclist travels 50 miles in 3 hrs. 6 min. 40 sec. What was his rate in feet per second?

391. I own 4 out of 75 shares in a business. What will be my share of a profit of $19,837.56?

392. How many times does a wheel whose circumference is $18\frac{1}{3}$ ft. turn in going $2\frac{7}{11}$ mi.?

393. Extract from a farmer's note-book, January, 1885:

Animals.	Daily Rations.					No. of Animals Jan. 1.	Notes.
	Oats. qts.	Meal. qts.	Hay. lbs.	Straw. lbs.	Roots. lbs.		
Horses,	12		16	12		7	Jan. 4, sold 2 cows.
Oxen,		4	8	10	30	9	Jan. 9, sold 1 cow.
Cows,		2	14	10	20	11	Jan. 12, sold 1 horse.
Sheep,			3	2	10	62	Jan. 12, sold 41 sheep.
							Jan. 16, bought 3 oxen.
							Jan. 16, bought 35 sheep.

Hence, find the total consumption of each article of food for the month.

394. If a postman walk $3\frac{3}{4}$ mi. every morning, and $2\frac{7}{8}$ mi. every evening, how far will he walk between Jan. 1, 1888, and the end of the following June, supposing no delivery of letters on Sundays?

395. A bequest of $251.28 is left to 7 men and 10 women, so that each man is to have twice the share of each woman. How must it be divided?

396. A farmer hires two farms, of 53 A. and 27 A. respectively. He pays $8.40 an acre for the one, and $6.80 an acre for the other. After paying $499.20 in money, how much wheat at $1.35 per bushel must he give to make up the remainder of his rent?

397. The leading-wheels of a locomotive are 5 yds. 2 ft. 2 in. in circumference; the driving-wheels, 8 yds. 1 ft. 9 in. How often will the former turn while the latter turn 618 times? and what distance will have been run?

398. Find the G.C.M. of 116,039, 122,067, and 137,137.

399. A cargo steamer leaves port at the rate of $8\frac{1}{2}$ mi. per hour at 3 A.M. on Monday. At midnight, Monday night, a despatch boat starts in pursuit at the rate of 15 mi. an hour. When will they be in sight of one another, supposing them to be visible 6 mi. off?

400. I am asked to supply a ton of fusible metal consisting of 8 parts by weight of bismuth, 5 lead, and 3 tin. The only bismuth I happen to have in stock is in an alloy consisting of 9 parts of bismuth, 4 lead, and 3 tin. How much of my alloy must I take, and how much lead and tin must I add to make up the order?

401. Two wheels in gear have, respectively, 10 teeth and 64 teeth. How many times will the smaller revolve while the larger revolves 575 times?

402. A, B, C are three places on a river, A and C being equally distant from B. A boat can go from A to B and back in $5\frac{1}{4}$ hrs., and from A to C in 7 hrs. How long would it take to go from C to A?

403. The new English ordinance maps are made on the scale of 25 in. to the mile. The map of a certain parish is 5 sq. ft. in area. Find the number of acres in the parish.

404. At a collection after a sermon the boxes were found to contain 4 five-dollar bills, 9 one-dollar bills, 22 half-dollars, 34 quarters, 73 dimes, 96 half-dimes, and 118 nickels. What was the sum collected?

405. A fire is maintained in a stove 14 hrs. daily, from Nov. 1 to May 1. The price of coal is \$7.50 per ton, and the stove consumes on the average $2\frac{1}{2}$ lbs. of coal per hour. Find the total cost of maintaining the fire.

406. Reduce 10 min. to the decimal of a day.

407. Mr. B engages a seamstress to make him one dozen of shirts. She pays $12\frac{1}{2}$ cents per yard for the cloth, and 60 cents apiece for the bosoms, and charges him 15 cents apiece for thread and buttons, and 50 cents apiece for the making. What is the amount of her bill, allowing $3\frac{1}{4}$ yds. of cloth to each shirt?

408. If a man saves \$77.40 out of a yearly income of \$1260, how much does he spend per day?

409. A dealer in notions paid \$7.20 for 12 bunches of feathers, each bunch containing 12 doz. of feathers. How many feathers should he sell for 5 cents in order that his profit may amount to \$3.60?

410. Mr. Glaisher, when in a balloon 4 mi. from the earth, heard a railway train directly below him. How many seconds was the sound in reaching him if it travelled at the rate of 1100 ft. per second?

411. How many days are there from Dec. 17, 1887, to Oct. 3, 1888, both dates included? Express the result as the fraction of a year.

412. Divide the product of 17.161 and 0.098 by the product of 1.31 and 64.33.

413. Find to the nearest second the time occupied by light in passing to the planet Neptune from the sun, the velocity of light being 186,000 mi. per second, and the distance 2746 millions of miles.

414. How many times must I walk round a garden 80 ft. long and 36 ft. wide in order to walk 3 mi.?

415. Sound travels 1120 ft. per second. What is the distance of a thunder-cloud when the thunder is heard $17\frac{2}{5}$ sec. after the lightning is seen?

416. Europe contains 3,375,860 sq. mi., and Australia contains 4,255,000. How much larger is Australia than Europe? Find the population of each, if Europe has 90 inhabitants to the square mile, and Australia 3 inhabitants to every 4 sq. mi.

417. A man sold $\frac{6}{11}$ of his farm, and then $\frac{1}{5}$ of the remainder; he then had 44 A. left. How many acres were there in his farm?

418. A market-woman bought eggs at 18 cents per dozen, and sold them at the rate of 5 eggs for 8 cents. After the day's sales were finished she found that she had made just 48 cents on the eggs. How many eggs had she sold?

419. Divide 288 lbs. between A and B so that if A give B $\frac{1}{7}$ of his share, they may have equal weights.

420. Which is the faster rate, 42 mi. per hour or 20 yds. per second? By how many yards per minute is one rate faster than the other?

421. How much will it cost to carpet a room 21 ft. long and 18 ft. wide, with carpeting $\frac{3}{4}$ of a yard wide, the strips running across the room, at $1.75 per yard, if there is no waste in matching the pattern?

422. A room is 16 ft. long, 14 ft. wide, and 10 ft. high. It has 3 windows 6 ft. by $3\frac{1}{4}$ ft., 2 doors 7 ft. by 3 ft., and the baseboard is 9 in. wide. Find the cost of plastering the room at 15 cents per square yard.

423. A milkman takes 2 qts. of milk from a can containing 2 gals. of milk, and fills the can with water. Seeing, however, that his supply of milk is still likely to run short, he pours out 2 qts. more from the can and fills up with water. How many quarts of milk are left in the can?

424. A tank contains 3027 gals. of water. To empty it three cocks are opened, which allow to flow out per minute, the first $4\frac{1}{3}$ qts., the second $3\frac{1}{4}$ qts., and the third $2\frac{5}{6}$ qts. In how many minutes will the tank be empty?

425. The great bell of Moscow weighs 202 long tons. If bell-metal consists of 77 parts copper and 23 parts tin, how many tons of copper and of tin are there in the bell?

426. If a walk 4 ft. wide is made round a park 300 ft. square within the enclosure, how many square yards will it contain?

427. How many bushels of grain will a bin hold that is 15 ft. long, $6\frac{1}{2}$ ft. wide, and $3\frac{3}{4}$ ft. deep?

428. A man who had 332 gals. 2 qts. 1 pt. of wine sold 239 gals. 3 qts. 1 pt., at 25 cents per pint, and then bottled the rest in bottles each holding 1 pt. 3 gi. How many pints did he sell? How much did he receive for what he sold? How many bottles did he fill?

429. How many pickets 3 in. wide, placed 3 in. apart, will be required to fence a lot 99 ft. by 231 ft., and what will they cost, at $3.25 per C.?

430. How many yards of carpeting $\frac{3}{4}$ of a yard wide will be required for a floor 18 ft. long, 16 ft. 4 in. wide, if the strips run lengthwise of the room, and there is a waste of $\frac{1}{2}$ of a yard in each strip in matching the pattern?

431. An apothecary bought 15 lbs. of opium, at $10.24 per pound avoirdupois, and sold the same in pills of 1 gr. each, at the rate of 25 cents for 10 pills. How much did he gain?

432. A grocer buys 30 hhds. of molasses, containing each 122 gals., at 54 cents per gallon, and sells them at 70 cents per gallon. What profit does he make, allowing a waste of 6 gals. for each hogshead?

433. A gentleman's income amounts to $4000. He pays $800 for rent; his average daily outlay for food and servants is $3.20; the cost of light for the year is $21; and of heat, $116; and he pays out during the year $550 for clothing and for the education of his children; he also puts $800 in the savings bank. How much of his salary is left for incidental expenses?

434. The length of the sidereal year is 365.2564 dys. Express the decimal fraction in hours, minutes, and seconds.

435. A bookseller bought 912 copies of a dictionary, at the rate of $45 per hundred. He sold 400 of them in lots of 10 each, at $6 per lot. How much apiece must he ask for the remainder to make $50 by the transaction?

436. A grocer has two hogsheads of molasses: one contains 100 gals., but the quantity in the other is unknown. He has paid for the molasses 60 cents per gallon, and he sells it all at 75 cents per gallon thereby gaining $27. How many gallons did the second hogshead contain?

437. To pay an election bet, Mr. Mullen had to sell peanuts on Boston Common until the profit amounted to $50. If he can sell 2 bu. an hour, and the profit is 4 cents per quart, how long will it take him to pay the bet, and how many quarts of peanuts must he sell?

438. Find the expense of erecting 7 mi. 1300 yds. of telegraph wire at $120 per mile; also the cost of the same length of wire at $8 per hundredweight (100 lbs.), reckoning 1000 yds. to the ton.

439. Reduce to their lowest terms the fractions $\frac{6381}{15584}$, $\frac{6821}{17282}$, and then subtract the less from the greater.

440. The Flying-Dutchman Express runs from London to Exeter, a distance of $193\frac{1}{8}$ mi. in $4\frac{1}{4}$ hrs., making one stop of 10 min., two of 5 min. each, and one of 3 min., on the way. What is its average speed when in motion?

441. The Scotch Express runs from London to Edinburgh, a distance of $393\frac{3}{5}$ mi. in 9 hrs. making one stop of 30 min., three of 5 min. each, and one of 3 min. on the way. What is its average speed when in motion?

442. A runs a mile in $5\frac{5}{12}$ min.; B, in $5\frac{7}{30}$ min. Which is the faster runner? By how many seconds would he win in a mile race?

443. If \$8853.66 are divided equally among 909 persons, how much will each person receive?

444. For repairing a road, a town employs 6 men who work each 10 hrs. a day, and together repair 15 yds. in one hour. The road is $3\frac{1}{4}$ mi. long. How many days will the men be employed; and what will the work cost, if each man receives 25 cents per hour?

445. Reduce 5 hrs. to the decimal of a day.

446. A grocer owes a silversmith for 3 doz. of tablespoons, at \$10.92 per dozen, and 4 doz. of teaspoons, at \$9.06 per dozen. How much tea at 92 cents a pound will cancel the debt?

447. How many dollars, worth 4 *s.* 2 *d.* each, will pay a bill of £11 17 *s.* 6 *d.*?

448. Divide 0.07504 by 23.45, and 0.00044408 by 112, and add your results.

449. After drawing off 132 gals. of water from a cistern, it was found to be just $\frac{3}{7}$ full. How many gallons will the cistern hold?

450. If a roll of paper a mile long will just cover 1210 sq. yds., how wide is the paper? What will the roll weigh, if $6\frac{1}{4}$ yds. weigh $7\frac{1}{2}$ oz.?

451. A contractor estimates that he can complete a piece of work in 51 dys. by employing 28 men. At the end of 34 dys. he wishes to engage additional men enough to finish the work in 14 more days. How many men must he engage?

452. If 50 yds. of silk worth $1.08 per yard are exchanged for 30 yds. of cloth, at what price per yard is the cloth reckoned?

453. The lunar month is 29.53 dys. Express this value in days, hours, minutes, and seconds.

454. A laborer is in the habit of spending 10 cents daily for beer, and 20 cents a week for tobacco. If he gives up the habit, how many yards of carpeting at 90 cents per yard could he purchase with the money saved in one year?

455. A can do a piece of work in 6 dys., and B can do it in 7 dys. If they work together for 2 dys., and A then leaves, how long will it take B to finish the work?

456. If 35 yds. are equal to 32 meters, and 3 meters of silk cost 84 frs., and 1 fr. is equal to 20 cents, what will 5 yds. of silk cost?

457. Express $\frac{1}{76}$ of a common year in days, hours, etc., and subtract the result from a week.

458. A boy has a certain sum of money, of which he spends $\frac{2}{3}$, and then $\frac{1}{3}$ of the remainder, and he has $1.22 left. How much had he at first?

459. Reduce to their lowest terms the fractions $\frac{6559}{14055}$, $\frac{8459}{18456}$, and then subtract the less from the greater.

460. A clothier bought 175 yds. of cloth at $2.82 per yard, and retailed it at $3.24 per yard. What did he gain on the whole?

461. A man bought a piano for $600, a writing-desk for $140, and an easy-chair for $30, and paid for them in ten-dollar gold pieces. What was the whole sum paid? How many ten-dollar pieces were paid for each article, and how many all together?

462. A farmer buys 25 sheep for $180, and 17 more for $125. What will he gain by selling the whole at $7.87½ each?

463. If a boat 63 ft. long travel $\frac{3}{7}$ of its length each stroke, how many strokes will be required in rowing a course of $\frac{11}{88}$ of a mile?

464. Multiply 2 mi. 3 fur. 117 yds. by 67½.

465. A watch is set right at 9.15 A.M., and it gains 3⅛ min. every hour. At what o'clock will it have gained exactly $\frac{3}{4}$ of an hour, and what time will it then indicate?

466. How many miles will be travelled between 11.40 A.M. and 4 P.M., at an average rate of 27¼ mi. per hour for 2 hrs. 25 min., and of 43½ mi. per hour for the remainder of the time?

467. A man bought 35 sheep at $19.20 a head. He sold 7 sheep at $25.20 a head. At what price per head must he sell the others in order to gain $140 on the whole?

468. Divide $36 among 5 persons so that the shares of two of them shall each be $2.40 less than the shares of each of the others.

469. Reduce $\frac{7}{16}$ of 2½ yds. to the fraction of a rod.

470. If I can walk 350 yds. in 2 min. 40 sec., how long will it take me to walk 560 yds.? And how far can I walk in 3 min. 44 sec.?

471. Simplify $7 - 2\frac{1}{27} + 3\frac{17}{24} - 5\frac{5}{6} + 3\frac{7}{18} + 1\frac{2}{9} - \frac{35}{36}$.

472. From a field of rye containing 4 A. 64 sq. rds. a farmer obtains 84 bu. of rye worth 90 cents per bushel, and 3 t. 18 cwt. of straw worth $10.50 per ton. What is the gross income per acre from the field?

473. A box containing 9 doz. pairs of kid gloves was offered at $97.20. What was the price per pair?

474. A man bought at the same rate per acre two fields, one containing 28 A. 40 sq. rds., the other 34 A. 52⅘ sq. rds. The larger field cost $456 more than the other. What was the cost of each field?

475. The rails of a railroad weigh 70 lbs. per yard, and cost $42 per ton. Find the cost of the rails needed to build a double-tracked road 64 miles long.

476. A bushel of wheat weighs 60 lbs., and 100 lbs. of wheat yield 74¼ lbs. of farina. When wheat is worth 90 cents per bushel, what is the value of farina per hundredweight, disregarding the cost of making it?

477. A gentleman spends on the average $10.44 daily. At the end of the year he has saved $1680. What is his yearly income?

478. I use 4 lamps, each burning ⅛ of a pint of oil per hour, and keep them burning for 4 hrs. each evening. On the evening of Oct. 13 I began to supply them with oil from a 40-gallon cask full of oil. On what date will the cask be empty?

479. A cistern holding 200 gals. is filled by 2 pipes. One pipe supplies 0.15 of a gallon per second, the other 1⅗ qts. per second. If the first is turned on for 10 min. and afterwards both run together, in what time will the cistern be filled?

480. A barometer, in four successive days, rose 0.135, 0.044, 0.095, and 0.573 in. respectively. It then fell 0.021 and 0.417 in. in the two next days. If the first reading was 29.024 in., find the last reading.

481. Bronze consists of 4½ parts of copper to 1 part of tin; how much copper must be added to 656½ lbs. of tin to make bronze?

482. Simplify $1\frac{1}{8} \times \frac{21\frac{1}{2} - 9\frac{5}{6}}{8\frac{2}{3} + 5\frac{3}{16}} \times \frac{6\frac{19}{11}}{4\frac{1}{5} \text{ of } 9\frac{1}{11}}$.

483. The total length of the lines of railway open in the United Kingdom in 1872 and in 1882, with total traffic receipts and working expenses, were as follows:

	Total Length.	*Total Receipts.*	*Total Expenses.*
1872,	15,814 mi.	£51,304,114	£26,293,304
1882,	18,457 mi.	£66,537,128	£36,170,436

Find for each year to the nearest penny the net receipts per mile.

484. If the scale of a map is 25 in. to the mile, how many sq. ft. will there be in the map of a town containing 4800 A.?

485. A, B, and C agree to do a piece of work for $12.60. A does $\frac{2}{7}$ of it, and then goes away; B does $\frac{1}{3}$ of what A leaves; and then C finishes the work. What sum of money should each man receive?

486. Find the value in days, hours, etc., of 2.723 dys. + 4.659 hrs. + 21.234 min. + 7.36 sec.

487. A man starts at 9 A.M. on a journey of 21 miles, walking $3\frac{1}{2}$ mi. per hour. At 11.48 A.M. he quickens his pace by $\frac{1}{2}$ mi. per hour. At what o'clock will he arrive at the end of his journey, and how much sooner than if he had kept on at his original rate?

488. By what number must you multiply 49 in order to diminish it by 35?

489. What fraction of 21 cu. yds. 11 cu. ft. 1215 cu. in. are 3 cu. yds. 1 cu. ft. 1161 cu. in.?

490. The mean daily temperatures registered during a certain week in January were, 7°, 3.6°, −9°, 6°, −3°, 0°, 8°; find the average temperature for the week.

491. A boy can swim in still water 1 yd. per second, and a stream flows at the rate of 15 yds. per minute. How far can the boy swim down the stream in 10 min.? How long will it take him to swim 180 yds. up the stream?

492. The longitude of Pekin is 116° 29′ E. of Greenwich, and of Chicago 87° 40′ W. of Greenwich. What is the mean solar time at Chicago when it is midnight at Pekin?

493. Air weighs $\frac{1}{770}$ as much as water, and a cubic foot of water weighs 62½ lbs. very nearly. How many cubic feet of air will weigh 1 lb.?

494. A crew can row 12 mi. an hour in still water. How long will they be in rowing 3½ mi. against a stream whose rate is 2 mi. an hour? How far could they row down the stream in 23 min.?

495. An imperial gallon of water weighs 10 lbs., and a cubic foot of water weighs 1000 oz.; how many imperial gallons are there in a cistern containing 64 cu. ft.?

496. I have three lamps. The first burns $\frac{4}{5}$ as much as the second, and the third burns 9 pts. of oil while the second burns 10 pts. If the third burns a pint of oil in 6 hrs., in what time will the first burn a pint of oil?

497. The moon revolves around the earth in 27 dys. 7 hrs. 43 min. Express this interval as a decimal number with the day for the unit.

498. A man who has bought 342.45 A. of pasture land, at $18.25 per acre, wishes to sell it so as to realize a profit of $500. He divides the land into nine equal lots, and sells seven of them at $19.40 per acre. What price per acre must he ask for the other two lots?

499. Find the total product of each principal crop produced in Massachusetts in 1880, from the following data:

	Number of Acres.	*Average yield per Acre.*
Indian corn,	55,980	33.5 bushels.
Buckwheat,	5,212	20. "
Rye,	24,600	17.5 "
Oats,	23,139	31. "
Potatoes,	41,620	126. "
Hay,	799,714	1.08 tons.

500. A clock which loses 35 min. daily, is set exactly right at noon. What is the correct time when this clock indicates 10.30 P.M. of the same day?

501. Simplify $\frac{8\frac{5}{12} - 4\frac{1}{2} \times (1 - \frac{2}{3})}{\frac{11}{24} + 18 \div 3\frac{3}{11}} - 2\frac{1}{7}$ of $\frac{7}{18}$.

502. Simplify $3\frac{1}{8} \times 5\frac{2}{5} - 2\frac{1}{10} \times 1\frac{2}{7} - 4\frac{1}{5} \times 3\frac{1}{8} + 1054\frac{1}{40}$.

503. If 1 lb. of dry oak wood has $\frac{14}{15}$ of the heating power of 1 lb. of coal, and 1 cd. of oak wood weighs 3610 lbs., and costs $10.50, what must be the price of coal per ton to make it just as cheap to burn the one as the other?

504. In an estate of 3779 A. 16 sq. rds., the roads occupy 66 A. 48 sq. rds. What fraction of the estate is occupied by the roads?

505. If 1 yd. = 0.9144 meters, how many meters are there in $1\frac{1}{2}$ mi.?

506. Light travels 186,000 mi. per second. What is the distance from the earth to the sun, if light takes 8.1583 min. to travel the distance?

507. Starting at 10.10 A.M. I find I have walked $6\frac{1}{2}$ mi. by 11.45 A.M.; I then walk at a slower rate $8\frac{1}{4}$ mi. further by 1.55 P.M. What was my average rate in miles per hour at first? During the last $8\frac{1}{4}$ mi.? For the whole journey?

508. What is the value of 127 mi. 224 rds. of telegraph wire, at $35.28 per mile?

509. Simplify $\dfrac{17\frac{3}{4}-(4\frac{1}{6}\times 3\frac{2}{5})}{13\frac{1}{9}-(2\frac{1}{7}\times 5\frac{1}{4})}\div 10\frac{3}{4}$.

510. Four bells toll at intervals of 3, 4, 5, and 8 sec., respectively, commencing at the same instant; at what intervals will they toll simultaneously?

511. Simplify $2\frac{1}{2}\times 3\frac{1}{4}-3\frac{1}{5}\times 4\frac{1}{6}-2\frac{1}{8}\times 5\frac{1}{3}+1098\frac{1}{12}$.

512. If the range of a gun is 9500 yds., what is it in kilometers? (One kilometer = 1094 yds.)

513. From a heap of shot weighing $3\frac{1}{2}$ lbs. 560 shot are taken, and the heap is then found to weigh $2\frac{1}{4}$ lbs. Find the weight of a single shot, and the number originally in the heap.

514. Reduce 3 wks. 4 dys. 20 hrs. 6 min. to the decimal of 60 dys.

515. A can do a piece of work in 3 dys.; B can do twice as much in 5 dys.; and C three times as much in 7 dys. How long will it take them, working together, to do five times the original work?

516. A vessel holds $4\frac{7}{12}$ qts. How many times can it be filled from a tank holding $94\frac{3}{16}$ gals., and how much water will remain?

517. Simplify $\dfrac{1-\frac{1}{3}\times(\frac{1}{2}+\frac{1}{7})}{1-\dfrac{1}{2-\frac{1}{4}}}$.

518. Reduce 3 yds. 2 ft. 9 in. to the decimal of 5 mi.

519. After drawing 5 gals. from a cask, and then half of what was left, the remainder, sold at 6 cents a pint, produced $3.36. What did the cask hold when full?

520. A can walk $4\frac{1}{2}$ mi. per hour; and B can walk 110 yds. per min. Which is the faster walker, and in what time would he overtake the other, if the latter have 2 min. the start?

521. At what times between 4 and 5 o'clock are the hands of a clock at right angles? together? opposite?

522. It is 3.13 P.M. mean sun time at a place A when it is 11.44 A.M. at a place B. Find the difference in longitude between A and B.

523. Multiply 2 dys. 15 hrs. 35 min. 14 sec. by $3\frac{5}{11}$.

524. The length of a journey is 82 mi. If I go $\frac{3}{4}$ of it by rail, at 41 mi. per hour; $\frac{1}{10}$ by coach, at 7 mi. per hour; and walk the rest of the way, at $3\frac{3}{5}$ mi. per hour, how long will it take me to make the journey?

525. If a knot is $\frac{1}{60}$ of a degree, and a mile is 0.01477 of a degree, find the value of a knot (to four decimal places) in terms of a mile.

526. What number contains 1832 as often as 6.9 contains 0.023?

527. If the telegraph poles by the side of a railway are placed at intervals of 70 yds., at what rate in miles per hour is a train travelling, which passes three of these intervals in 11 sec.?

528. By what fraction must you divide 62 in order to increase it by $12\frac{1}{2}$?

529. Simplify $3\frac{5}{7}$ of $\dfrac{13\frac{1}{2} - 5\frac{1}{3}}{19\frac{1}{7} - 15\frac{3}{28}} \div 1\frac{1}{48} - \frac{49}{113}$.

530. A very good soil is one $\frac{3}{5}$ of which is clay, $\frac{3}{10}$ is sand, and the remainder is lime. How many pounds of each substance are there in 70 lbs. of this soil?

531. If $\frac{2}{3}$ and then $\frac{1}{5}$ of a piece of cloth are sold, and $3\frac{1}{3}$ yds. remain, what was the whole length of the piece?

532. The amount of juice in the sugar-beet is $\frac{18}{20}$ of its weight, but the amount that can be extracted is only $\frac{12}{15}$. How many pounds of sugar-beets are required to furnish 1000 lbs. of juice, and how much juice will be thrown away with the pulp?

533. There is a barn 40 ft. long, and each side of the roof is 20 ft. wide. It is shingled with shingles 18 in. long, and averaging 4 in. wide. The shingles lie $\frac{1}{3}$ to the weather. How many bunches of a quarter-thousand each will be required to cover the roof?

534. A man engaged to work a year for $360 and a suit of clothes. At the end of 8 mos. he quit work on account of sickness, and received for his wages the suit of clothes and $220. Find the value of the suit of clothes.

535. If it is worth $1 to saw a cord of wood consisting of sticks 4 ft. long into pieces $1\frac{1}{3}$ ft. in length, how much is it worth to saw a cord consisting of sticks 8 ft. long into pieces of the same length?

536. A boat, whose rate in still water is 14 mi. per hour, is 10 hrs. longer in going up a river a certain distance than in coming down the same distance. Find this distance, knowing that the current of the river is $2\frac{1}{2}$ mi. an hour.

537. The longitude of Boston is 71° 4′ W. What is the time by the sun at Boston when it is 3.35 A.M., June 9, in London (long. 0° 5′ W.)?

538. The captain of a steamer, sailing from London to New York, found on taking an observation, that the sun crossed his meridian at 1 hr. 42 min. 50 sec. P.M. by Greenwich time. Find his longitude.

CHAPTER V.

PERCENTAGE.

What per cent of a number is:

1. 0.05? 0.10? 0.45? $0.06\frac{1}{4}$? 0.8?
2. 0.6? 0.155? 0.875? 0.2875? 0.16?
3. 1.20? 2.50? 3.625? 4.015? 6.375?
4. $\frac{1}{2}$? $\frac{1}{4}$? $\frac{3}{4}$? $\frac{3}{8}$? $\frac{3}{5}$? $\frac{7}{8}$? $\frac{9}{8}$? $\frac{15}{16}$?
5. $\frac{1}{8}$? $\frac{4}{5}$? $\frac{17}{20}$? $\frac{9}{25}$? $\frac{3}{50}$? $\frac{1}{80}$? $\frac{3}{40}$?
6. $\frac{1}{40}$? $\frac{4}{15}$? $\frac{2}{7}$? $\frac{8}{65}$? $\frac{1}{200}$? $\frac{39}{156}$? $\frac{21}{105}$?

What decimal fraction of a number is:

7. 10%? 60%? $70\frac{1}{2}$%? $92\frac{1}{4}$%? $87\frac{1}{2}$%?
8. 20%? 20.5%? 83.17%? 144%? 256%?
9. $35\frac{1}{4}$%? $4\frac{3}{4}$%? 216.75%? 1.18%? 12.5%?

What common fraction of a number is:

10. 5%? 15%? $6\frac{1}{4}$%? $33\frac{1}{3}$%? 60%?
11. 45%? $12\frac{1}{2}$%? $16\frac{2}{3}$%? $66\frac{2}{3}$%? 70%?
12. $\frac{5}{8}$%? $6\frac{7}{10}$%? $114\frac{2}{7}$%? $222\frac{2}{9}$%? $93\frac{1}{4}$%?

Find:

13. 18% of \$1297.
14. 11% of \$1000.
15. 5% of \$742.10.
16. $47\frac{3}{4}$% of \$7893.
17. $87\frac{1}{2}$% of \$1624.50.
18. $2\frac{1}{4}$% of \$7135.80.
19. $8\frac{3}{4}$% of \$777.50.
20. $12\frac{1}{2}$% of \$994.70.

21. What per cent of 200 is 4?

22. What per cent of 480 is 12?

23. What per cent of 16,400 is 2624?

24. What per cent of 270 is 90?

25. What per cent of 90 is 270?

26. What per cent of 8217 is 1643.4?

27. What per cent of 4530 is 6040?

28. What per cent of 10,400 is 650?

29. A merchant imports 2740 boxes of oranges, and finds upon receiving them that 548 boxes are decayed. What per cent of the whole number was decayed?

30. A gentleman purchases a farm for $7490, and agrees to pay 10% down, 17% at the end of the first year, 27% at the end of the second year, and the remainder at the end of the third year. Find the amount of each payment.

31. A brick kiln contained 29,800 bricks, and, after burning, it was found that only 24,734 were in good condition. What per cent had been spoiled in burning?

32. What is the difference between $4\frac{1}{2}\%$ of $740 and $2\frac{1}{2}\%$ of $1680?

33. A house worth $4000 rents for $360 a year. What per cent of its value is the rent?

34. If 24 bu. of corn are raised from 1 pk. of corn, what per cent is the increase?

35. For the fiscal year 1885, the revenue of the United States was $181,471,939, and the expense of collecting it was $6,494,847. What per cent (to two decimal places) was the latter sum of the former?

36. 87 is 20% of what number?

37. 40 is $6\frac{1}{4}$% of what number?

38. 620 is $33\frac{1}{3}$% of what number?

39. 24832.08 is 36% of what number?

40. 4140.15 is $8\frac{3}{4}$% of what number?

41. $2\frac{5}{8}$ is 3% of what number?

42. $\frac{1}{4}$ is $12\frac{1}{2}$% of what number?

43. 0.08 is $16\frac{2}{3}$% of what number?

44. 630 is 140% of what number?

45. 190 is 250% of what number?

46. The population of Arizona increased between 1870 and 1880 from 9658 to 40,440. Find (to two decimal places) the increase per cent.

47. The population of a city increased 30,000 in ten years, a gain of 24%. What was the population at the beginning and the end of the period?

48. A clerk spent 50% of his salary for board, 20% for clothes, and 8% for amusements, and saved $330. What was his salary?

49. A man owning 30% of a mine gave 25% of his share to his son, who sold what he received for $12,000. What was the value of the mine?

50. A farmer raised 20% more corn this year than last, and 25% more last year than the year before, when he raised 160 bu. How many bushels did he raise this year?

51. In a barrel of alcohol containing 36 gals., the water is 20% of the spirit. How many gallons of each?

52. If milk yields 18% of cream, and cream yields 24% of butter, and a quart of milk weighs 1 lb., how many quarts of milk will yield 470 lbs. of butter?

53. 145 is 25% more than what number?

54. 91 is 40% more than what number?

55. 39 is 40% less than what number?

56. 297 is $12\frac{1}{2}$% more than what number?

57. 110 is $66\frac{2}{3}$% less than what number?

58. 1240 is 55% more than what number?

59. 260 is $33\frac{1}{3}$% less than what number?

60. 901 is $6\frac{1}{4}$% more than what number?

61. What number increased by 27% becomes 5.08?

62. What number diminished by $16\frac{2}{3}$% becomes 60?

63. What fraction increased by $37\frac{1}{2}$% becomes 1?

64. What fraction diminished by 60% becomes $\frac{1}{10}$?

65. If I am offered 8% for the use of money for one year, what sum must I lend in order to receive \$972 at the end of the year?

66. Iron expands 0.64% of its length when heated from the freezing-point of water to the boiling-point. If an iron bar surrounded by boiling water is 10 ft. long, find its length (to the nearest inch) when placed on ice.

67. A man sold a house for \$6800, which was 15% less than what the house cost him. What did the house cost him?

68. Add together 25% of \$763.22, 16% of \$847.16, and $6\frac{1}{4}$% of \$1234.17.

69. The cattle of a ranch have been increased 600% since the ranch was established. They now number 1400. What was the original number?

70. If the population of a city has increased 35% during the last ten years, and is now 113,400, what was the population ten years ago?

What must be the selling price of a thing:

71. Costing \$4 in order to gain 25%?

72. Costing \$12 in order to lose 12½%?

73. Costing \$3.50 in order to lose 18%?

74. Costing \$225 in order to gain 200%?

What per cent is gained or lost if a thing:

75. Cost \$6 and is sold for \$5?

76. Cost \$0.62½ and is sold for \$0.50?

77. Cost \$1360 and is sold for \$1428?

78. Cost \$1700 and is sold so as to gain \$204?

79. A man bought a horse for \$250. What price must he ask for him in order to gain 40%?

80. If I buy flour at \$5.25 per barrel, and sell it at \$6.25, what is the gain per cent?

81. If 80 cds. of wood are bought at \$4.50 per cord, and sold so as to gain 33⅓%, what amount of money is gained?

82. What per cent is made by buying coal by the long ton and selling it by the short ton, at the same price?

83. How many pounds of sugar costing 5 cents per pound must be sold for a dollar, in order to gain 25%?

84. If I buy cloth at \$2.75 per yard, and sell it at \$3.10, what is the gain per cent?

85. If 125 overcoats cost \$2500, for what must they be sold apiece in order to gain 7½%?

86. A grocer bought 120 bbls. of apples, each containing 2 bu. 1 pk., at \$1.50 per barrel, and paid \$14.40 to have them brought to his store. If the loss from shrinkage and decay amounts to 20%, what is the lowest price per peck at which he can sell them in order to be sure of clearing 10% on his outlay?

What is the cost of a thing if:

87. 20% is gained by selling it for $60?

88. 20% is lost by selling it for $60?

89. $5\frac{1}{12}$% is gained, and the sum gained is $38.12½?

90. 2½% is lost, and the sum lost is $20.25?

91. 150% is gained, and the sum gained is $36,000?

92. 150% is gained, and the selling price is $36,000?

93. By selling milk at 6 cents per quart, a milkman gains 50%. What did the milk cost him?

94. A grocer lost 15% by selling a 40-lb. tub of butter for $17. What did the butter cost him per pound?

95. A man sold a house for $2360, which was 10% less than cost. What did the house cost him?

96. A merchant gained 17% by selling a quantity of velvet for $3789.40. What did he pay for the velvet?

97. If I buy cloth at $2 per yard, and silk at $2.80 per yard, and sell the cloth at $2.50 per yard, at what price must I sell the silk to make the profit on one the same as on the other?

98. A gunsmith gained 20% by selling revolvers at $8.75 each. What was the sum gained on 30 revolvers?

99. I sold a horse for $425, thereby losing 15%. For what ought I to have sold him to gain 20%?

100. If 15% is gained by selling 80 sheep for $1104, at what price apiece should they have been sold in order to make 25%?

101. A merchant lost 10% by selling flour at $4.50 per barrel. If he had sold it at $5.75 per barrel, what would have been the gain per cent?

102. What must I ask for a watch costing $30, in order to take off 10% for cash, and yet make a profit of 20%?

103. A commission merchant sold 625 bu. of potatoes at 80 cents per bushel, and received $4\frac{1}{2}\%$ commission. What was his commission?

104. What is the rate of commission when \$36 are paid for selling \$1600 worth of goods?

105. An agent sells 718 bbls. of flour, at \$7.13 per barrel. What is his commission, at $4\frac{1}{4}\%$?

106. A real-estate broker sold a house on 3% commission, and sent to the owner as net proceeds \$2425. For what sum was the house sold?

107. A book-agent sells books on 20% commission until his commission amounts to \$500. What sum ought he to remit to the owner of the books?

108. A Boston merchant sent \$10,000 to Chicago to be expended for wheat, the agent to receive 2% commission. What sum was expended for the wheat?

109. An agent in New Orleans received \$5125 with which to buy molasses, after deducting $2\frac{1}{2}\%$ on the sum expended. What was the agent's commission?

110. A lawyer collected 60% of a debt of \$1600, and charged 5% on the sum collected. What did the creditor receive?

111. An agent sold 220 bu. of oats at 75 cents a bushel, and his commission amounted to \$5.28. What rate of commission was charged?

112. A broker sold for a farmer 14,400 lbs. of beef, at $10\frac{1}{2}$ cents per pound, and 850 bu. of corn at 72 cents per bushel. He charged 3% commission for selling, and paid \$40.28 for freight. How much land, at 10 cents per square foot, can the broker buy with the net proceeds, after deducting a commission of 1% for buying?

113. What will it cost to insure a house valued at $4500, the rate of premium being $\frac{1}{4}\%$?

114. Find the premium to be paid for insuring a store worth $6000 for $\frac{2}{3}$ of its value, the rate being $\frac{1}{8}\%$.

115. What is the rate of insurance, if $225 is paid for an insurance policy for $18,000?

116. A man paid $345.30 for insuring a cargo of sugar at $1\frac{1}{2}\%$. For what amount was the sugar insured?

117. A merchant shipped a cargo of flour worth $72,750 to Liverpool. For what must he insure it at 3% to cover the value of the flour and the premium?

118. A stock of goods worth $24,000 was insured for $\frac{3}{4}$ of its value at $1\frac{1}{8}\%$. If the whole stock is burned, what will be the loss to the owner, including the premium paid for insurance?

119. What sum must be insured at $2\frac{1}{4}\%$ on property worth $15,000, so that in case the property is destroyed the owner will suffer no loss?

120. A vessel worth $33,000 is insured at $5\frac{3}{4}\%$ for such a sum that, in case it becomes a total wreck, the owners recover both the worth of the vessel and the insurance premium. For what sum is it insured?

121. If a mill worth $7800, and insured at the rate of $1\frac{1}{4}\%$ for $\frac{3}{4}$ of its value, is half destroyed by fire, what is the exact loss to the Insurance Company?

122. What annual premium at $1\frac{3}{5}\%$ must be paid on a life insurance of $5000?

123. At the rate of $16 upon $1000, what annual premium must be paid on a life insurance of $4800?

124. If the annual premium paid for a life insurance at $1\frac{1}{2}\%$ is $135, what is the sum insured?

The census of 1880 gives the financial condition, for that year, of every city in the United States having a population exceeding 7500. The following table, compiled from the census reports, exhibits the condition as regards taxation of fifteen cities. Of these, the first twelve are taken in pairs from certain States, and the two cities of each pair have respectively the highest and the lowest tax rates of all the cities of the State in which they are located.

Name.	*Population.*	*Assessed Valuation.*	*Tax Levied.*
Portsmouth, N.H. . . .	9,690	$6,553,079	$135,565
Dover, N.H.	11,687	7,080,178	107,318
Hartford, Ct.	42,551	46,255,340	1,288,661
Danbury, Ct.	11,666	5,136,529	63,495
Shamokin, Pa.	8,184	548,491	29,871
Norristown, Pa. . . .	13,063	6,802,077	80,375
Toledo, Ohio	50,137	18,687,955	685,129
Steubenville, Ohio . . .	12,093	5,173,520	85,880
La Salle, Ill.	7,847	699,450	49,322
Elgin, Ill.	8,787	1,857,717	39,859
Des Moines, Iowa . . .	22,408	4,361,090	225,894
Dubuque, Iowa . . .	22,254	13,000,000	260,951
Boston, Mass.	362,839	613,322,691	7,666,534
Baltimore, Md. . . .	332,313	244,043,181	2,977,580
Chicago, Ill.	503,185	117,970,035	5,112,375

From the figures above given find (i.) the valuation per capita (to the nearest dollar); (ii.) the tax per capita (to the nearest cent); (iii.) the tax rate per $100 (to the nearest cent) for:

125. Portsmouth.
126. Dover.
127. Hartford.
128. Danbury.
129. Shamokin.
130. Norristown.
131. Toledo.
132. Steubenville.
133. La Salle.
134. Elgin.
135. Des Moines.
136. Dubuque.
137. Boston.
138. Baltimore.
139. Chicago.

NOTE. In the following examples, the tariff rates named are those imposed by the Tariff Act of 1883.

140. What is the duty on 800 doz. bottles of Hoff's Malt Extract, the invoice value being $1.80 per dozen, and the tariff rate being 50% ad valorem?

141. A merchant tailor imported woollen cloths as follows: 340 lbs. invoiced at $1.25 per pound; 716 lbs. invoiced at $1.10 per pound; and 836 lbs. invoiced at $1.05 per pound. How much duty did he have to pay, the rate being 35 cents per pound, and 40% ad valorem?

142. What duty must be paid on an oil painting valued at $3200, the rate being 30%?

143. Find the duty on 3600 pint-bottles of cologne water, invoiced at $3 per gallon, the tariff being $2 per gallon, and 50% ad valorem.

144. A tobacconist imported 20,000 cigars, net weight 240 lbs., paying for them $3.75 per hundred, and for freight, etc., $12.50. The tariff on cigars is $2.50 per lb. and 25% ad valorem. What profit would be made by retailing the cigars at the rate of 8 for $1?

145. Find the duty on 4000 yds. of Brussels carpeting at $1.10 per yard, and 2400 yds. of Wilton carpeting at $1.85 per yard, the tariff being 30% ad valorem, and in addition, 30 cents per yard on the former, and 45 cents per yard on the latter.

146. What amount of duty must be paid on 800 doz. quart-bottles of sherry wine, the tariff being $1.60 per dozen, and in addition 3 cents on every bottle?

147. A commission house received an invoice of 1000 silk umbrellas valued at $2.25 each, 600 clocks valued at $16 each, and 800 watches valued at $40 each. Find the duty, the rates being 50% on the umbrellas, 30% on the clocks, and 25% on the watches.

Find the simple interest of:

148. $1 for 11 yrs. 7 mos., at 6%.
149. $1 for 12 yrs. 5 mos., at 6%.
150. $279.40 for 3 yrs. 2 mos., at 6%.
151. $189.70 for 6 yrs. 7 mos., at 6%.
152. $1463 for 3 yrs. 11 mos., at 6%.
153. $1 for 66 dys., at 6%.
154. $1 for 8 mos. 12 dys., at 6%.
155. $1 for 2 yrs. 2 mos. 19 dys., at 6%.
156. $917.30 for 7 mos. 17 dys., at 6%.
157. $842.50 for 3 mos. 13 dys., at 6%.
158. $573.83 for 2 yrs. 11 mos. 10 dys., at 6%.
159. $709.63 for 4 yrs. 7 mos. 16 dys., at 6%.
160. $68.70 for 3 yrs. 4 mos. 27 dys., at 6%.
161. $742.63 for 3 yrs. 28 dys., at 6%.
162. $6250 for 1 yr., at 5%.
163. $21,850 for 3 yrs., at 4½%.
164. $21,750 for 1 yr. 7 mos., at 4½%.
165. $945 for 2 yrs. 5 mos. 8 dys., at 5%.
166. $1800 for 3 yrs. 5 mos. 8 dys., at 5%.
167. $715.30 for 3 yrs. 7 mos. 10 dys., at 8%.
168. $1234.56 for 4 yrs. 4 mos. 25 dys., at 7%.
169. $576 for 3 yrs. 5 mos. 7 dys., at 10%.

Find the amount of:

170. $1200 for 93 dys., at 8%.
171. $200 for 7 yrs. 4 mos. 11 dys., at 6%.
172. $743.63 for 9 yrs. 3 mos. 9 dys., at 6%.
173. $7766.55 for 100 dys., at 5%.
174. $500 for 8 yrs. 8 mos. 8 dys., at 16%.

Find the simple interest of:

175. $300 from April 1 to Sept. 18, at 6%.
176. $600 from May 5 to Dec. 17, at 7%.
177. $758.50 from Jan. 5 to July 1, at 9%.
178. $2500 from Nov. 15, 1888, to Mar. 1, 1889, at 5%.
179. $638.40 from June 7 to Oct. 31, at 6½%.
180. $750 from Aug. 8, 1887, to Mar. 20, 1889, at 7%.
181. $3650 from April 5, 1888, to Aug. 15, 1890, at 7½%.
182. $780 from May 9 to Dec. 11, at 8%.
183. $1830 from Aug. 16, 1887, to June 19, 1888, at 7%.

Find the amount of:

184. $175 from Sept. 26, 1888, to Mar. 10, 1889, at 8%.
185. $613 from Oct. 20, 1888, to May 22, 1889, at 5%.
186. $684.84 from Feb. 1, 1888, to Mar. 10, 1889, at 7%.
187. $3605 from Aug. 8, 1888, to Mar. 11, 1889, at 6½%.
188. $2017 from Jan. 18 to Mar. 20, at 6½%.
189. $620 from Mar. 1 to Aug. 26, at 7%.
190. $6200 from Sept. 3, 1886, to Jan. 9, 1887, at 6%.
191. $254.72 from Dec. 20, 1885, to July 11, 1887, at 9%.

Find the rate per cent, if:

192. The interest on $24,840 for 1 yr. is $869.40.
193. The interest on $14,500 for 1 mo. is $84.56.
194. The interest on $680 for 7 mos. is $35.70.
195. The interest on $24 for 2 yrs. 5 mos. is $3.19.
196. The amount of $700 for 5 yrs. is $1200.
197. The amount of $750 for 4 yrs. is $900.
198. A sum of money doubles itself in 16 yrs. 8 mos.
199. A sum of money quadruples itself in 3 yrs.

Find the time in which:

200. The interest on $2130 will be $436.65, at 6%.
201. The interest on $675 will be $108, at 8%.
202. $2000 will amount to $2500, at 4%.
203. A sum of money will double itself, at 4½%.
204. The interest at 4½% will equal ⅝ of the principal.
205. A sum of money will quadruple itself, at 23%.
206. $270 will give $87 interest, at 7%.
207. $273 will give $100 interest, at 9%.
208. $640 will amount to $1000, at 5%.

Find the principal that will:

209. Produce $572 interest annually, at 4½%.
210. Produce $830 interest annually, at 4⅔%.
211. Produce $325 interest annually, at 5½%.
212. Produce $32.10 interest in 5 mos., at 4%.
213. Produce $150.10 interest in 3 mos. 2 dys., at 8½%.
214. Produce $873.30 interest in 3 yrs. 5 mos., at 6%.
215. Produce $161.25 interest in 3 yrs. 9 mos., at 8%.
216. Produce $100 per month, at 7%.
217. Produce $500 quarterly, at 5%.
218. Amount to $9050 in 1 yr., at 5%.
219. Amount to $840 in 3 yrs., at 4%.
220. Amount to $1500 in 3 yrs. 4 mos., at 6%.
221. Amount to $100 in 6 mos., at 20%.
222. Amount to $3500 in 5 yrs., at 8%.
223. Amount to $4810 in 4 yrs. 6 mos., at 4½%.
224. Amount to $2551.50 in 13 mos., at 5%.
225. Amount to $2000 in 20 yrs., at 8%.
226. Amount to $1111.11 in 11 yrs., at 11%.

227. Which will yield the greater income, to loan \$13,500 at $6\frac{1}{2}\%$ per annum, or to buy a store with the money and rent it for \$850 per annum?

228. Is it better to loan \$17,450 at 6%, or to buy a store with the money and rent it for \$1200?

229. A man bought, Mar. 12, goods to the value of \$325, and, having no ready money, gave his note payable Nov. 12 of the same year, with interest at 6%. How much money did he have to pay?

230. How much money is required to yield \$2900 interest annually, if $\frac{2}{5}$ of the money is invested at 5% and the remainder at $4\frac{1}{2}\%$?

231. April 1 a man put \$500 in a savings-bank, and July 15 following he put in \$360 more. Jan. 1 he received as interest \$18.90. What was the rate per cent?

232. A note for \$620, dated Oct. 18, 1886, payable on demand, with interest at 6%, bears the following indorsements: Nov. 25, 1886, \$47.50; Dec. 28, 1886, \$108.93; Feb. 11, 1887, \$216.18; June 6, 1887, \$60.10; Sept. 2, 1887, \$183.25. What is due Nov. 10, 1887?

233. A note for \$1217.30, dated June 2, 1887, payable on demand, with interest at 6%, bears the following indorsements: July 17, 1887, \$207.80; Oct. 6, 1887, \$209.60; Dec. 11, 1887, \$320.90; Mar. 29, 1888, \$421.83. How much is due Oct. 7, 1888?

234. A note for \$1200, dated June 17, 1887, drawing interest at 6%, bears the following indorsements: Feb. 15, 1888, \$125; Nov. 30, 1888, \$75; Sept. 19, 1889, \$20; Jan. 1, 1890, \$45; July 9, 1890, \$500. What was due on this note Jan. 1, 1891?

Find the compound interest of:

235. $80 compounded annually for 3 yrs, at 6%.

236. $150 compounded annually for 6 yrs., at 7%.

237. $200 compounded semi-annually for 2 yrs., at 8%.

238. $1800 for 5 yrs., at 6% per annum.

239. $700 for $3\frac{1}{2}$ yrs., at 14% per annum, compounded semi-annually.

Find the amount at compound interest of:

240. $100 for $8\frac{1}{2}$ yrs., at 5% per annum.

241. $4500 for 10 yrs., at 5% per annum.

242. $3500 for 12 yrs., at $4\frac{1}{2}$% per annum.

243. $875 for 11 yrs., at 6% per annum.

244. $1 for 45 yrs., at 6% per annum.

245. $78.20 for 7 yrs., at 12% per annum, interest payable every 3 mos.

246. $860 for 3 yrs., at 8% per annum, interest payable semi-annually.

247. What sum of money will amount to $6000 in 10 yrs., at 4% per annum, compound interest?

248. What sum of money will amount to $7439.87 in 7 yrs., at 4% per annum, compound interest?

249. At what rate per cent, compound interest, compounded annually, will $4000 increase in 10 yrs. to $6000?

250. At what rate per cent, compound interest, will a sum of money triple itself in 25 yrs.?

251. For what period must $5000 be placed at 4%, compound interest, in order that the capital and interest together may amount to $9000?

252. In what period of time will a sum of money placed at 5% compound interest double itself?

Find the day of maturity, and the proceeds of the following notes:

253. A note dated Aug. 31, 1886, payable in 4 mos., face value $2045.82, discounted Sept. 2, at 7%.

254. A note dated Sept. 3, 1886, payable in 5 mos., face value $15,000, discounted Sept. 3, at 6¾%.

255. A note dated Sept. 3, 1887, payable in 3 mos., face value $2000, discounted Sept. 3, at 7%.

256. A note dated Sept. 3, payable in 45 dys., face value $600, discounted Sept. 3, at 6%.

257. A note dated July 3, payable in 2 mos., face value $4821.23, discounted Aug. 3, at 5%.

258. A note dated Mar. 5, payable in 6 mos., face value $1392.30, discounted Aug. 13, at 5½%.

259. A note dated Mar. 8, payable in 6 mos., face value $10,500, discounted Mar. 8, at 4½%.

260. A note dated Mar. 14, payable in 4 mos., face value $5000, discounted Mar. 14, at 7%.

261. A note dated Oct. 8, payable in 60 dys., face value $4263, discounted Oct. 8, at 6½%.

262. A note dated Jan. 11, payable in 3 mos., face value $520.25, discounted Jan. 21, at 7%.

263. A note dated May 10, payable in 4 mos., face value $6425.80, discounted May 17, at 10%.

264. A note dated Feb. 4, 1886, payable in 40 dys., face value $125, discounted Feb. 5, at 7½%.

265. A note dated July 3, payable in 2 mos., face value $340.82, discounted July 6, at 6%.

266. A note dated Oct. 1, 1886, payable in 4 mos., face value $25,000, discounted Oct. 1, at 5¾%.

Find the date of maturity and proceeds of the following:

267. A note dated Sept. 25, payable in 47 dys., face value $6000, discounted the same day at $6\frac{1}{4}\%$.

268. A note dated Mar. 6, payable in 3 mos., face value $3000, discounted April 10, at $4\frac{3}{4}\%$.

269. A note dated Nov. 10, payable in 45 dys., face value $7010.10, discounted Nov. 12, at 6%.

270. A note dated June 20, payable in 3 mos., face value $576.74, discounted June 25, at $6\frac{1}{2}\%$.

271. Find the face value of a note for 4 mos., in order that the proceeds may be $5000 when discounted at 6%.

272. Find the face value of a note for 60 dys., in order that the proceeds may be $1000 when discounted at $4\frac{1}{2}\%$.

273. Find the face value of a note for 30 dys., in order that the proceeds may be $3000 when discounted at 5%.

274. Find the face value of a note for 3 mos., in order that the proceeds may be $600 when discounted at $5\frac{1}{2}\%$.

275. Find the face value of a note for 45 dys., in order that the proceeds may be $7864.17 when discounted at 4%.

276. Find the face value of a note for 4 mos., in order that the proceeds may be $5893.41 when discounted at 6%.

277. On Mar. 4 a man obtained $10,000 from a bank by giving his note for the same amount payable on demand. He redeemed the note Mar. 14. What sum did the bank receive for the note, the rate of interest being 6%?

278. A bank holds a note dated Nov. 4, payable on demand, face value $20,000. What sum is required to redeem this note if paid Nov. 15, the rate of interest being 5%?

279. When the rate of discount is 6%, find the proceeds of a note for $930, payable Aug. 1, and discounted at a bank April 1.

Find the present worth of:

280. $962 due in 1 yr., at 4%.

281. $500 due in 1 yr., at 5%.

282. $650 due in 1 yr., at 5%.

283. $2180 due in 1 yr., at 5%.

284. $1700 due in 2 yrs., at 6%.

285. $650 due in 5 mos., at 5%.

286. $1726 due in 14 mos., at 6%.

287. $925 due in 3 mos., at 5%.

288. $1710 due in 90 dys., at 6%.

289. $2202 due in 5 yrs. 9 mos., at 6%.

290. $1003.50 due in 8 mos., at 6%.

291. $716 due in 7 mos., at 7%.

292. $1342.50 due in 125 dys., at 6½%.

293. $4360 due in 1 yr. 5 mos., at 6%.

294. $1647 due in 11 mos., at 6%.

295. $2000 due in 3 yrs. 7 mos., at 6%.

296. $970.63 due in 11 mos., at 8%.

297. What sum of money paid Mar. 16 will cancel a note for $1125 due Aug. 20, if money is worth 7%?

298. A legacy of $2400 was left to me in May, to be paid on the next Christmas day. What is its value in cash on May 3, if money is worth 5%?

299. What sum discounted for 6 mos., at 4½% per annum, will yield a cash value of $900?

300. Find the difference between the bank discount and the true discount of a note for $1600, payable in 10 mos., at 6%.

301. Find the true discount on $3224, at 7%, one-half payable in 6 mos., and the remainder in 12 mos.

302. Find the net amount of a bill of \$1200, 10% off being allowed for cash.

303. Find the net amount of a bill of \$1550, 5% off being allowed for cash.

304. Find the net amount of a bill of \$88, discounts being 20 and 10.

HINT. This means, that a discount of 20% is allowed, and then a discount of 10% on the remainder.

305. Find the net amount of a bill of \$209.25, discounts being 50 and 10.

306. Find the net amount of a bill of \$3, discounts being 25 and 10.

307. Find the net amount of a bill of \$150, discounts being 30 and 10.

308. Find the net amount of a bill of \$2.70, discounts being 50 and 10.

309. Find the net cash amount of a bill of \$800, discounts being 75 and 5, and an additional discount of $2\frac{1}{2}$% for cash.

310. Find the net cash amount of a bill of \$272, discounts being 50 and 10, and an additional discount of 5% for cash.

311. Find the net cash amount of a bill of \$1440, discounts being 55 and 10, and an additional discount of 5% for cash.

312. Find the net cash amount of a bill of \$1125, discounts being 50, 10, 10, 10; or, as it is commonly expressed, 50 and 3 tens.

313. Find the cost of 40 shares of railroad stock, at 92.

314. Find the cost of 120 shares of bank stock, at $137\frac{3}{8}$.

315. A man owns 40 United States 4% bonds of $1000 each. What are they worth in cash when the market quotation for them is $87\frac{1}{2}$?

316. How many shares (par value $100) of Union Pacific can be bought with $1625, the market value being $65?

317. When Atchison sells at 92, and pays 6% per annum, what will be the cost of 60 shares, and what income will be derived from them?

318. Bought 27 shares of a 4% stock, at 80, brokerage $0.25 per share. What did the stock cost me, and what income did it yield?

319. The trustees of an academy invested $70,000 in Old Colony Railroad stock when it was selling 40% above par. If the stock pays 8%, how much of the annual dividend will be left after paying the expenses of the academy, amounting to $3300?

320. Will $3336 yield a larger income if invested in an 8% stock at 139, or if loaned at 6% simple interest, and what is the difference of income in the two cases?

321. A man sold 150 sheep, at $22 each, and invested the proceeds in a 6% stock, at 110. What income did he derive from the investment?

322. A man bought 265 shares of a 3% stock when it was $50\frac{1}{4}$, and sold it at $65\frac{1}{2}$. Find his profit per cent and his total profit.

323. I buy 500 shares of Western Union, at $78\frac{1}{2}$. What must be the market value of the stock, that I may gain 10% on my money by selling, brokerage being $\frac{1}{4}$% on each transaction?

Which will yield the larger income (the sums invested being supposed the same in both cases):

324. A 3% stock at 71, or a 4½% stock at 102?

325. A 3% stock at 73, or a 4½% stock at 104?

326. A 6% stock at 120, or an 8% stock at 160?

327. A 6% stock at 110, or an 8% stock at 144?

328. A 6% stock at 93, or a 10% stock at 172?

329. A 4% stock at 75, or a 9% stock at 167?

330. When a 4% stock is quoted at 90, what should be the price of a 5% stock, that it may yield the same income?

331. What must be the price of 4½% bonds of $1000 each, to yield an income equal to that of 5% bonds which sell at par?

332. A railroad costing, all told, ten millions yielded a net income of $750,000. What annual dividend will a man receive who owns 250 shares of the stock?

333. What sum of money must a man invest in a 9% stock, selling at 207, brokerage 25 cents per share, in order that the annual income derived from it may be $360, and what rate per cent does he receive on his investment?

334. If an 8% stock is worth 152, what rate of interest will a purchaser receive on his money?

335. What sum must be invested in 3% bonds at 85, that the income may be $1200, brokerage at ¼% included?

336. What amount of bank stock does a man hold if his quarterly dividend at 7% per annum is $294?

337. What must be the price of an 8% stock, that a buyer may receive 6% on his investment?

338. What sum invested in Government 6s, at 126¼ will yield an annual income of $1800?

339. What income do Government 4s yield at 124?

340. Find the cost of a sight draft on Chicago, for \$3500, at $\frac{3}{4}\%$ premium.

341. Find the cost of a draft on Atlanta, payable 60 dys. after sight, for \$4000, with exchange at $1\frac{1}{2}\%$ premium, and interest at 6%.

342. Find the cost of a draft on San Francisco, for \$1500, payable in 90 dys., with exchange at $\frac{1}{2}\%$ discount, and interest at 6%.

343. The par of exchange between the United States and Great Britain is \$4.8665 for the pound sterling. What will a sight draft on London for £800 cost, if exchange is $1\frac{1}{4}\%$ premium?

344. Find the cost of a draft in Boston on New Orleans, at 30 dys., for \$2500, exchange being at $\frac{1}{2}\%$ premium, and bank discount being at 6%.

345. Find the cost of sending a bill of 10,000 marks to Hamburg, by first sending a bill of the required amount to Paris, exchange in New York on Paris being 5.15 francs per dollar, and in Paris on Hamburg 1.24 francs per mark.

346. What must be paid in New York for a draft on Minneapolis, for \$2400, payable 90 dys. after sight, at a premium of $1\frac{3}{8}\%$, reckoning bank discount at 7%?

347. Find the face of a draft which cost \$4053.09, exchange being at a premium of $1\frac{1}{8}\%$.

348. A banker in New York remits \$12,000 to London, as follows: first, to Paris, at 5.32 francs per dollar; from Paris to Hamburg, at 1.8 francs per mark; from Hamburg to London, at 14 marks per £1 sterling. How many pounds sterling does he gain by this method over direct exchange at \$4.87 for £1 sterling?

349. Find the cost of a sterling bill on London for £897 2 *s.*, when sterling exchange is at $\$4.86\frac{3}{8}$.

MISCELLANEOUS.

(Including also the subjects treated in the preceding chapters.)

350. What per cent is 17 of 85? 25 of 1000? 3.5 of 50?

351. If sold at an advance of $33\frac{1}{3}\%$, what will be received for a dozen and a half pencils which cost a cent and a half each?

352. In 1882 the total immigration into the United States amounted to the unusually large aggregate of 788,992. Of these, 76,342 were Irish. What per cent (to two decimal places) is this of the whole number for that year?

353. A cheese weighing 42 lbs. was sold for $9.08. What was the price per pound? If the profit to the seller was 2 cents per pound, what is the per cent profit?

354. The quotient of an example in division is 379, the divisor 257, and the remainder 73. What is the dividend?

355. Five dozen eggs are packed equally in three baskets, and the contents of each basket are equally distributed among five poor persons. How many eggs does each person receive?

356. Find the cost of $19\frac{1}{2}$ yds. of cloth, if when sold for 36 cents a yard there is a loss of 22%.

357. Find 10% of that number which divided by 437 will give 129 for a quotient and leave 78 for a remainder.

358. In 1880, out of 227,542 emigrants from the United Kingdom, 111,845 were English, and 22,056 were Scotch. How many were Irish? What per cent of the whole number were the English, Scotch, and Irish, respectively?

359. The circumferences of the large and small wheels of a bicycle are 176 and 48 inches, respectively. How many more turns will the latter make than the former in going 15 mi.?

360. If by selling a house for $2650 a man gain 6% on the cost, what would be the gain or loss per cent if the house had been sold for only $2300?

361. The population of Texas was 818,579 in 1870, and 1,591,749 in 1880. Find (i.) the numerical increase, (ii.) the per cent of increase.

362. The population of the State of New York in 1870 was 4,382,759, and in 1880 it was 5,082,871. Find the increase per cent.

363. Find the amount of $50, at compound interest, for 18 mos. at 16%, interest compounded once in six months.

364. In what time will $700 be increased 0.15 of itself, at $2\frac{1}{2}\%$ per annum?

365. Find the interest on $125 for $2\frac{1}{2}$ yrs. at 4%.

366. Find the interest on $3000 for 6 mos. 24 dys. at $7\frac{1}{2}\%$ per annum.

367. Compute from the following data, supplied by the census of 1880, the per cent of illiterate population in the States mentioned, for persons ten years of age and upward:

	Whole Number.	*Number unable to read.*
Massachusetts,	1,432,183	75,635
New York,	3,981,428	166,625
Ohio,	2,399,367	86,754
Iowa,	1,181,641	28,117
South Carolina,	667,456	321,780
Louisiana,	649,070	297,312

368. The population of Kansas between 1870 and 1880 increased from 364,399 to 996,096. What was the amount of increase, and what was the per cent of increase?

369. During 1881 there were in the United Kingdom 1,135,672 births, and 654,199 deaths. During the same year 243,002 emigrants left the Kingdom, and 77,105 immigrants entered it. What was the change in the total population for the year, and what per cent of the emigrants were the immigrants?

370. A man owns a paper-mill valued at $12,000. For one year his expenses are, for repairs $50, for insurance $45, for taxes $1\frac{1}{4}\%$ on $\frac{3}{4}$ of the valuation. What rent must he receive to gain 6% on the value of the mill and pay the outlays?

371. Find the time in which $1000 will gain $200 at 8% per annum.

372. At $\frac{1}{2}$ of 1% what sum can be insured for $80?

373. Three Germans own a silver mine in Nevada. Hans Heuser owns $41\frac{2}{3}\%$ of it; Karl Krantz, $33\frac{1}{3}\%$; and Fritz Stenck, 25%. If the mine is sold for 4300, what sum does each receive?

374. A boy sells two books for $1 each, and thus gains 25% on one and loses 25% on the other. Find the cost of the books, and the total gain or loss.

375. If the interest on a note, at $7\frac{1}{2}\%$ for 1 yr., be $174.36, what would it be at $8\frac{3}{4}\%$?

376. Find the gain or loss per cent in buying lemons at 66 cents per hundred and selling them at eight for $2\frac{1}{2}$ cents.

377. In what time will money double itself at $1\frac{1}{3}\%$ a month simple interest?

378. What is the rate when the insurance of \$18,000 costs \$36, exclusive of the policy?

379. A boy bought 20 peaches at 2 cents. each, and sold them at the rate of 2 for 7 cents. What was his total gain and his gain per cent?

380. At what rate of simple interest will money double itself in 3 yrs.? 7 yrs.? 9 yrs.? 11 yrs.? 16 yrs.? 20 yrs.?

381. What will be gained by selling, at $24\frac{1}{2}\%$ premium, six \$100 United States bonds, bought at par?

382. At 3%, what principal will yield \$12.64 in 1 yr.?

383. What per cent of 625 is $28\frac{1}{8}$? 300 is 25% of what number?

384. At what rate will \$750 amount to \$783.75 in 1 yr.?

385. Sugar-cane yields 0.9 of its weight of juice, and 100 lbs. of juice contain 17 lbs. of sugar. Half the sugar is usually lost in the process of manufacture. What weight of sugar-cane is required to make 300 lbs. of sugar?

386. On the following bill, find the amount due in 6 mos. after its date, interest reckoned at $7\frac{1}{10}$: 50 pieces of silk, $30\frac{1}{2}$ yds. each, at \$2.50; 22 coats, at \$40; 15 pieces of flannel, 110 yds. each, at \$0.32; 20 pieces of diagonal, 95 yds. each, at \$0.38; 60 pieces of linen, 12 yds. each, at \$0.50.

387. A man invests his net profit for 1 yr. in $5\frac{1}{2}\%$ mining stock, at 105, and another man with his surplus income buys $4\frac{1}{4}\%$ bank stock, at $81\frac{1}{8}$. Which is the better investment? Write a clear explanation of the technical terms used in the example.

388. In 4 mos., at 2% a month, what principal will amount to \$5265?

389. In 1 wk. a newsboy sold 360 papers, which were 90% of his whole stock. How many papers had he left?

390. When 3% bonds are 10% below par, how much money must be invested in them to secure an income of $2000.

391. The number of persons engaged in the four chief classes of occupations in the United States in 1870 and in 1880 were as follows:

	1870.	1880.
Agriculture,	5,922,471	7,670,493
Professional and personal service,	2,684,793	4,074,238
Trade and Transportation,	1,191,238	1,810,256
Manufactures and mining,	2,707,421	3,837,112

Find (i.) the increase in number, (ii.) the per cent of increase, for each class of occupations for the decade.

392. At 10% per annum, what interest will a merchant receive on $9000 for 10 dys.?

393. The cost price of a book is 57 cents, the expense of sale is 6%, and the profit is 24%. What is the retail price?

394. Find from the following data of 1883 the dividend each road could have declared had it been free from debt:

Name.	*Capital Stock.*	*Net Earnings.*
Eastern,	$4,997,600	$1,273,676
Boston & Maine,	6,921,274	845,183
Boston & Lowell,	3,792,000	615,171
Fitchburg,	4,950,000	637,083
Boston & Albany,	20,000,000	1,945,053
Boston & Providence,	4,000,000	335,140
Old Colony,	10,248,620	1,228,441
New York & New England,	20,000,000	405,128

395. Find the bank discount on a note of $1600 for 3 mos.

396. A merchant received $1998.80 from his lawyer, who retained 5% on the debt for collecting. What amount was collected?

397. After losing a battle, a general found that he had but 66⅔% of the men under his command fit for action; 11⅓% had been wounded, and the remainder, 2000 men, had been killed or were missing. How many had he before the battle?

398. Compute the value of the silk goods consumed in the United States for the fiscal year ending June 30, 1883, from the following data:

Invoiced value of imported goods:	
Dress and piece goods,	$16,964,733
Hosiery,	820,088
Other manufactures,	18,979,455
Value of our own manufactures,	39,464,541

To the invoiced value of the imported goods the tariff of 50% must be added, and also 25% for estimated undervaluation.

399. Three men have agreed to drain a swamp. The first can do 8⅓%, the second 6⅔%, the third 5%, of the work in 1 day. In what time can it be accomplished when the three work together?

400. George Heath bought forty $100 railroad bonds at 90, and sold them immediately for 95. He invested the money in oats at 50 cents per bushel, paying 3% insurance, $300 freight and storage, and losing 2% in handling; and he then sold at an advance of 15 cents per bushel. How much did he gain or lose? What per cent?

401. What is the rate of interest when $800 gains $32 in 8 mos.?

402. Find the present worth and the discount of \$1245.50, due $3\frac{1}{2}$ yrs. hence, when money is worth 5%.

403. What amount must be assessed for building a bridge which is to cost \$10,000, when 6% of the sum levied will not be collected, and 5% of the sum collected must be allowed for collection?

404. A town paid \$9 for insuring the school furniture, books, etc., of a public school, the insurance being effected on $\frac{2}{3}$ the value of the property, at the rate of $\frac{3}{4}$%. What was the estimated cost of the articles insured?

405. A builder having a six-month note for \$2400 dated May 2, 1885, has it discounted at a bank on the 1st of June at 5%. At \$4 per thousand, how many thousands of shingles can he buy with the proceeds?

406. Find the discount and the present worth of \$750 due in 6 mos., when money is worth 5%.

407. A merchant fails, owing \$31,620, and has property to the amount of \$6324 above the necessary expenses for settling his affairs. How much money will the family dressmaker receive, whose bill is \$50?

408. A gentleman took for a debt of \$4624 a farm containing 150 A. He repaired the buildings, and let the farm at the rate of \$1.50 per acre, thus realizing $4\frac{1}{2}$% on his money. What was the cost of the repairs?

409. An iron-merchant purchased 550 long tons of iron at the importer's price, \$30 per ton. He paid for cartage and freight \$1200, and sold the iron at \$36 per ton of 2000 lbs. What was his gain per cent?

410. The net income of an estate, after deducting $4\frac{1}{8}$% for collection, and 4% on the remainder for other expenses, is \$437. What is the gross rental?

411. A wheat-grower in Minnesota had three six-month notes discounted at 5%, 6%, and 7%, respectively. Each note yielded $500 proceeds. What was the face of each?

412. The net income for a certain half-year of a railway company, whose capital is $29,480,000, shows an increase of $92,125 over that of the corresponding half of the previous year, when a dividend at the rate of $5\frac{3}{4}\%$ per annum was declared. What will be the rate of dividend for this half-year?

413. By selling a cotton crop for $777, a planter lost $7\frac{1}{2}\%$. For what should he have sold it to gain $12\frac{1}{2}\%$?

414. Three notes were discounted at a bank for 3 mos., 4 mos., and 6 mos., respectively, at 6%. The proceeds were $1200, $800, and $600. What was the sum of the notes?

415. How much cotton can be bought for $4379.125, allowing $2\frac{1}{2}\%$ commission for buying?

416. What must be the face of a note, that when discounted for 10 mos., at 5%, the avails may be $2000?

417. For what price must cloth be sold to gain 12%, when 15% is lost if it is sold at $2.50 per yard?

418. A grocer sold 180 boxes of lemons, at a loss of $36, which was 10% of their cost. What did he pay for them per box?

419. A certain railroad has 20% of its capital owned in Ohio, 25% of it in New York, 30% of it in Illinois, 5% of it in Maine, and the remainder, $240,000, in Michigan. Which State holds the largest amount of stock, and in what two States are equal amounts held?

420. A horse was sold for $132.50 at a gain of 6%. Had $115 been the price received, what would have been the loss per cent?

421. A speculator bought 250 hhds. of New Orleans molasses, and sold them for $10,645\frac{5}{8}$, at a gain of $16\frac{2}{3}\%$. What was the cost price per hogshead?

422. Find the discount and the present worth of $2400 at 6%, $\frac{1}{3}$ due in 3 mos., $\frac{1}{3}$ in 6 mos., and the remainder in 9 mos.

423. A man bought 180 tomato-plants for 2 for a cent, and 180 for 3 for a cent, and sold them all at the rate of 5 for 2 cents. What was the gain or loss per cent?

424. From a dividend of 17%, what income will be received from 56 shares (par value $100) in a Lowell calico-mill?

425. What was paid for $8000 Virginia 6s bought without a broker, at 10% discount?

426. In the year 1248 the Jews were not allowed to charge the Oxford students a higher rate of interest than 2 *d.* for the use of £1 for a week. How much is this per cent per annum?

427. $\frac{3}{4}$ of 128 is 5% of what number?

428. 0.75 of 64 is 2% of what number?

429. Six times 25 is 6% of what number?

430. Six-hundredths of 25 is 6 times what number?

431. 6% of 25 is .06 of what number?

432. Which stock yields the greater return, a $6\frac{1}{2}\%$ stock at $161\frac{1}{2}$, or a 5% stock at $123\frac{1}{2}$?

433. Required the face of a bank note due in 90 dys., whose proceeds shall be $3000, discount being reckoned at 6%.

434. For six $500 United States bonds $3262.50 were paid. At what premium were they sold?

435. A ranchman bought 768 head of cattle, an addition of 25% to the stock already owned by him. What was the number of his herd after the purchase?

436. At what rate per cent will $22,200 invested in bank stock at par yield a semiannual return of $999?

437. A sugar-planter obtained $3000 at a bank by having his note for 30 dys. discounted at 6%. Required the face of the note.

438. On a note for $1000 dated Jan. 1, 1875, there were four indorsements: Mar. 10, 1876, $40; Aug. 1, 1876, $271.18; Dec. 12, 1876, $40; May 5, 1877, $400. What was still due July 8, 1878?

439. When money is worth 4½% per annum, what is the present worth Aug. 1, of $100 due Nov. 1?

440. By selling tea at 56 cents per pound a grocer makes a profit equal to ⅐ of his outlay. What profit per cent will he make by selling the same tea at 60 cents per pound?

441. A six-penny piece is what per cent of 14 half-crowns?

442. A gentleman had a note for $1200 payable in 90 dys., discounted at a bank at 7%. He offered his son ½ the discount if he would reckon the difference between the true and the bank discount. The boy found the correct answer to the question. How much more than the required difference did he receive?

443. On the 1st of May, 1879, Jacob Jackson gave to his grocer a note to the amount of $315.74 on interest at 6%. The three following payments have been made on this note: Dec. 10, 1879, $20.60; Nov. 10, 1880, $30.50; July 1, 1881, $90. What was due Sept. 30, 1881?

444. What is the duty at 40% on 150 bales of cotton weighing 375 lbs. each, invoiced at 15 cents per pound, tare 10%?

445. On the note given below what remains due April 1, 1882?

$2600. ST. LOUIS, Sept. 4, 1880.

On demand I promise to pay Caleb Metcalf, for value received, twenty-six hundred dollars, with interest at seven per cent.

Indorsement, July 12, 1881, $1200. SETH JONES.

446. Find the day of maturity, the time to run, the discount, and the proceeds of the following note:

$325. BOSTON, Nov. 3, 1884.

For value received I promise to pay three hundred and twenty-five dollars, six months after date, with interest at six per cent.

Discounted at 7%, Jan. 3, 1885. CHARLES GALE.

447. What principal will give $63 interest in 2 yrs. 3 mos., at 8%?

448. A railroad company employs 336 men daily on a certain part of its line; this is 8% of the whole number of laborers. What is the entire force on the road?

449. A veteran in the civil war received from the government pension money amounting to $1251. On Jan. 1, 1884, he lent the money to his brother, who paid Jan. 1, 1885, $400; Nov. 1, 1885, $40; Jan. 1, 1886, $600. With interest at 6% what will be due May 1, 1886?

450. A young man invested his first earnings in a 6% $100 bond, at a price which paid him 5% on his money. What was the market value of the bond?

451. What must a merchant pay for a 6% investment, that it may bring him 9% annually?

452. Theophilus Jenkins sent to a broker in Cincinnati $5166 for the purchase of salt pork. How many barrels, at $24 each, can be bought, the broker's commission being 5% for buying?

453. Carl Heuser bought $1499.68 worth of Kentucky 7s at 105. What was his rate of income, and his actual income?

454. A settler in Arizona sold his farm for $\frac{7}{8}$ of its value. What was the loss per cent?

455. $500. GEORGETOWN, Jan. 1, 1876.

For value received I promise to pay Seth Wilton, or order, five hundred dollars, on demand, with interest at 6%. JOHN HURRY.

Indorsements: April 1, 1876, $12; Aug. 1, 1876, $2; Dec. 1, 1876, $3; Feb. 1, 1877, $30; July 1, 1877, $40. What is still due June 1, 1880?

456. If I wish to pay a coal-dealer a debt of $961.35 by giving him a note for 60 dys., which he can have discounted at a bank at 8%, what must be the face of the note?

457. A lumberman in California has two wood-lots of Sequoia trees. From one he cuts yearly 112 tons of timber: this amount is 40% more than the quantity he cuts from the other. How much timber does he cut from the other lot?

458. A man bought a farm on the 8th of May, 1881, for $7600, and gave his note bearing 6% interest from the time of the purchase, secured by a mortgage on the farm. Having made the payments given below, what balance had he to pay on taking up the mortgage Dec. 30, 1882?

Indorsements: Dec. 1, 1881, $240; Mar. 6, 1882, $1000; Nov. 19, 1882, $150.

459. The owner of a ranch in Colorado has 800 sheep in two pastures. In one pasture there are 480; what per cent of his entire flock is there in the other?

460. A merchant sold $165\frac{7}{10}$ hhds. of molasses at $\$33\frac{1}{2}$ each, and received in payment a note due in 5 mos. 15 dys. What sum will be received for the note if discounted at a bank immediately, at 7%?

461. A young lady received by bequest from her grandfather, Jan. 1, 1881, $1000. She invested it on compound interest at 7%, interest payable semiannually. What did the bequest amount to Jan. 1, 1884? What was the compound interest?

462. If hemp be bought at the rate of $17 per bale of 196 lbs., and sold at the rate of 20 lbs. for $2, what will be the gain per cent?

463. $1040.32. SPRINGFIELD, MASS., Dec. 1, 1885.

Sixty days after date I promise to pay to George Gordon, or order, one thousand forty and $\frac{32}{100}$ dollars, for value received.

Discounted at 6%, Feb. 1. WILLIAM BREWSTER.

It is required to find the day of maturity, the time to run, the discount, and the proceeds of the foregoing note.

464. When a tax of $31,500 is assessed on property valued at $630,000,000, what is the rate per $1000?

465. In what time will $800 at 6% gain $40 interest?

466. A man insured his life for $39,000, the annual premium being $4.91 on each $100 insured. What was the yearly payment required of him?

467. What will be the proceeds of a bank note, for 90 dys., for $1250 at 7%?

468. When 11 yrs. old, a boy received from his grandfather $15,000. What will be his age when this sum, placed at simple interest at 10%, shall amount to $30,000?

469. What will be the increase of income if $1250 of 3% stock at 96 be exchanged for railroad bonds at 75, paying an annual dividend of 2½%?

470. Henry Ives sold to John Carr two Alderney cows, at a loss of 12½%. J. Carr sold them to George Sumner for $504, and gained 12½% on the price he paid. What did the cows cost Henry Ives?

471. In settling an account, a carpenter took a note estimated to be worth only 50% of its face. He collected 13% more of the face of the note than the estimated value, and thereby gained $56. What sum was collected?

472. A carpenter buys 11,625 ft. of hemlock plank at $30 per M., and pays the bill with his note at 15 dys. The lumberman holds the note 3 dys., and then has it discounted at a bank, at 7%. How much money does he realize?

473. Find the proceeds and the discount of a note for $900, due in 6 mos., discounted at 8%.

474. What per cent of a number is 50% of 50%?

475. A grocer bought sugar at ⅛ discount from $9 per hundredweight. What per cent did he make by selling it at $9 per hundredweight?

476. What capital must be invested in bank stock at par in order to obtain $160 when an 8% dividend is declared?

477. A farmer sold for 60 cents per bushel corn which in its cultivation cost him 36 cents. What was the gain per cent and the actual gain on 90 bu.?

478. At $10\frac{1}{2}\%$ premium, what amount of bonds can be bought for $10,497.50, without brokerage?

479. A nurseryman marked his trees at 80% above cost, and then sold them at 75%, and 5% discount. What was the loss per cent?

480. What is the cost of a sight draft for $1000, the rate of exchange being $1\frac{1}{2}\%$ premium?

481. How many yards of silk $1\frac{1}{8}$ yds. wide are needed to line a portière which contains 20 yds. of silk $1\frac{1}{2}$ yds. wide?

482. A woman bought lemons at 30 cents per dozen, and sold them at the rate of 3 for 5 cents. What per cent did she lose?

483. What alteration in income will occur if $1000 of 6% stock be sold at 75, and the proceeds be invested in 7% stock at 110?

484. When exchange is $4.86\frac{1}{2}$, what is the face of a bill on Dublin for $29,190?

485. Find the cost of a bill on Amsterdam for 5252 florins, worth 40 cents each, at 1% premium.

486. The value of the capital invested in silk manufactures in New Jersey, in the year 1883, was $8,968,000, the amount paid for labor was $5,592,189, and the value of the product was $22,183,346. What per cent of the capital is the gross product? What per cent of the product is the amount paid for labor?

487. Find the proceeds and the discount, at 7%, of a bank note due in 3 mos.; face of the note $2000.

488. What sum will be raised by taxation in a town where the taxable property amounts to $4,200,000, and the rate is $1\frac{1}{2}$ mills on a dollar, 8% being uncollectable, and 3% being paid for collecting?

489. £409. BOSTON, Dec. 4, 1885.

Thirty days after sight of this first of exchange (second and third of the same tenor and date unpaid) pay to the order of Hiram Humphrey four hundred and nine pounds sterling, value received, and charge the same to Baring Brothers, London. ADAMS, ANTHONY & Co.

Find the cost of the preceding draft, thirty-day bills being quoted at $4.89.

490. Find the maturity, the time to run, the discount, and the proceeds of the note which follows:

$944. NEW YORK, Jan. 15, 1887.

Ten months from date I promise to pay George Johns or order nine hundred and forty-four dollars, value received.

Discounted, at 7%, Jan. 15. JAMES GAGE.

491. A grocer received $24 for the sale of sugar in one day. Of this sum 12% was gain. What was his gain per cent, and what the actual gain, on a sale amounting to $275?

492. A lady in Baltimore wishes to buy a draft on Paris for 5140 francs, when exchange is 5.14 francs to a dollar. What must she pay for it?

493. The assignee of a bankrupt broker found his assets to be real estate worth $3750; cash, $750; furniture, $650; horse and carriage, $200; interest in a flour-mill valued at $400. His aunt held a mortgage of $2250 on the real estate; he owed $3000 to his sister; $3825 to his father; and $2540 to his brother. The assignee had 5% on the assets, and other expenses amount to $350. In settling the estate, what sum will the brother receive?

494. What will be the net proceeds on the sale of goods which brought $13,242.50, after a commission of $2\frac{1}{4}$% has been deducted?

495. Find the cost in New York of a draft for £1500, payable to Longman, London, exchange being at $\$4.86\frac{1}{2}$.

496. A collection of natural history specimens, for which the owner paid $\$7350$, is insured for its full value, at $4\frac{7}{8}\%$. What would be the actual loss in money to the owner from its entire destruction by fire?

497. Orrin Heath, of Cincinnati, received $\$1230.38$ for the purchase of pork, after deducting his commission of $2\frac{1}{4}\%$. What sum did he invest?

498. George Levitt owes $\$500$ in Omaha. He pays the debt through an agent who is to receive for his services the difference between the $\$500$ and the face of a draft, payable 30 dys. after sight, which the $\$500$ will buy at $\frac{1}{4}$ of 1% premium. What sum did the agent receive?

499. Which is more profitable, a 6% stock at 85, or a 7% stock at 95? How much more income would be received by investing $\$16{,}150$ in the more profitable stock?

500. A Chicago library bought books of Rivingtons to the amount of £251 6 *s.* What will be the cost of a draft on London to settle the bill, sterling exchange being quoted at $\$4.85$?

501. A milliner sold her business for $\$182$, and lost 9%. Had she sold it for $\$214$, what would have been the gain per cent?

502. A bankrupt whose liabilities are $\$43{,}000$ has property to the amount of $\$16{,}500$. What will be paid on a claim of $\$1300$?

503. A merchant bought $\$5000$ worth of stock at 120, and sold it at 84. Without any allowance for interest or brokerage what was his loss, and what per cent of his investment did he lose?

504. A farmer living in Dakota sent 12 t. of maple sugar to a Chicago merchant, who paid 50 cents per hundredweight for storage, $3 for cartage, and reserved 2½% for commission. He remitted to the farmer $5727. Find the selling price of the sugar per pound.

505. A Boston apple-woman bought a certain number of apples at 3 for a cent, and an equal number for 2 for a cent. She then mixed them and sold them at 5 for 2 cents. What was the gain or loss per cent?

506. A merchant sold a 3% stock at 99, and gained 10% on his investment. He realized $15,345. What did the stock cost him? What income did it yield?

507. An avenue ½ of a mile long is lined with shade trees standing 60 ft. apart. (i.) How many trees are there? (ii.) Had they stood 33⅓% farther apart, how many trees would there have been?

508. Find the net proceeds of a consignment sold for $5700, on which there are charges of $470 freight, $500 insurance, and 3¼% commission.

509. A gentleman pays $285 premium for insuring his house and furniture at 2⅜%. What is the value of each, the furniture being worth ½ the sum at which the house is valued?

510. A real estate agent received $137.50 for effecting the sale of a house, the rate of commission being 2½%. For what sum was the property sold?

511. What sum must be invested in a stock, paying $7\frac{3}{10}$%, and worth 106¼ in market, that a college professorship may be endowed with a salary of $2044?

512. Find the principal that will gain $200 in 4 yrs. 6 mos., at 3%.

513. Fritz Rheinhart sent 3745 bbls. of flour from St. Paul to New York City to be sold by an agent on $3\frac{1}{4}\%$ commission. The flour brought $\$10\frac{1}{2}$ per barrel. Find the agent's commission?

514. Henry Hancock pays $3000 to a St. Louis flour-merchant, by a draft on Boston. What will be the face of the draft, Boston exchange being at $\frac{1}{8}$ of 1% premium in St. Louis?

515. Which is the better investment, $4\frac{3}{4}\%$ stock at 95, or 5% stock at 104? What investment must be made in the better stock to secure a yearly income of $613.60, after paying an income tax of $1\frac{3}{8}\%$?

516. Brown Brothers pay a bill for $3000 in Denver, Col., with a sight draft on New York. What will the draft be worth in Denver at $\frac{1}{12}$ of 1% premium?

517. Find the value in New York, at a discount of $\frac{1}{20}\%$, of a sight draft on Memphis for $3650.

518. An Alabama cotton-planter sent 284 bales of cotton, weighing 450 lbs. each, to his agent in Manchester, England. The agent sold it 12 *d.* per pound. He paid 1 *d.* per pound freight, £4 3 *s.* for storage, and charged $2\frac{1}{4}\%$ commission. What did the planter realize, with exchange on the net proceeds at $\$4.92\frac{1}{2}$ to the pound?

519. Elihu Enright collects 556 bills of $3.80 each for an agricultural society. His commission is 4%. How much must he pay over?

520. A ship, worth $17,500, is insured at $3\frac{1}{4}\%$ on $\frac{4}{5}$ of its value; and the cargo, valued at $37,500, is insured on $\frac{2}{3}$ of its value, at $2\frac{1}{2}\%$. Find the premium to be paid for the insurance of both ship and cargo.

521. An estate valued at $3000 is taxed $50. What tax must be paid on a house worth $1727.50 when the tax rate is half as much again?

522. A merchant agreeing to receive $500 on a bad debt, found that he had been paid 62½% of his actual claim What was the original amount of the debt?

523. What must be paid in United States money for a bill on Liverpool for £1100, the rate of exchange being $4.80?

524. Find the face in English money of a draft on Glasgow, that can be bought for $7297.50, exchange at $4.86½.

525. How much money in Birmingham will remit $600 to Chicago, when 48½ *d.* make $1?

526. When exchange on Paris is quoted at 5.15⅞ francs for $1, for what sum in francs must a bill be drawn to send $1000 for merchandise?

527. A dairyman sold the butter made from one week's milk for $38.25 at a loss of 8%, while his neighbor, by sending his butter to New York, received $57 net for the same quantity. What was the neighbor's gain per cent?

528. Find the sum of money which put at interest for 9 mos., at 4% per annum, will amount to $193.125.

529. James Stone bought an 8% stock at 120, and his brother bought a 5% stock at 75. Which investment yielded the better income?

530. Joseph Skinner, when 40 yrs. old, insured his life for $10,000; he died at 70. Without allowing interest on the payments, how much did they exceed the amount received from the insurance company? Rate, $46 per $1000.

531. Two brothers invest each the same sum in the 3 and $3\frac{1}{2}$ per cents, and receive an income of equal amount. The 3 per cents are at 75; at what price are the $3\frac{1}{2}$ per cents?

532. Find the cost of 6% bonds that they may bring $6\frac{2}{3}$% income.

533. What income will be received from \$14,350, invested in 6% bonds at $2\frac{1}{2}$% premium?

534. What is the value of a \$3064.90 draft on Chicago bought at $\frac{3}{8}$% discount?

535. Jared Moller sent coal to New York which was sold for \$2850; for freight and cartage \$485 was paid, and \$2272.37 was remitted from the sale. Find the amount of the agent's commission.

536. What investment in United States 4% bonds at $102\frac{7}{8}$ will yield a quarterly income of \$250?

537. A butcher adds 20% profit to the price of his meat. What is the cost price of a pair of chickens which he sells for \$2.04?

538. Silas Dresser transferred \$1000 of 3% bonds at 96 to 5% stock at 108. What difference of income was caused by the exchange?

539. A factor received \$48.35 for selling goods whose net proceeds amounted to 1709.99. What sum was paid for the goods?

540. Find the tax rate per \$1000 in a city where \$2,000,000 is raised on property valued at \$250,000,000.

541. By selling sugar at \$12 per barrel, a grocer lost 25%. At what price per barrel should the sugar have been sold to gain 25%?

542. What sum must be invested in 10% bonds selling at 104, to secure an annual income of \$1600?

543. David Secord bought 120 shares of mining stock at 97, and, after receiving a dividend of $2\frac{1}{2}\%$, sold the shares at par. What was the actual gain, and the gain per cent?

544. What principal at 6%, from Sept. 13, 1880, to Aug. 15, 1883, will amount to $11,532.57?

545. King & Co. of Chicago pay a New Orleans debt for $5000, by a sight draft on Chicago. What sum will settle the account, Chicago exchange being at $\frac{1}{10}\%$ premium in New Orleans?

546. In Massachusetts a certain fertilizer is made of 75 parts bone dust, 10 phosphate of lime, and 15 light loam? in Connecticut of 77 parts bone dust, 9 phosphate of lime, and 14 light loam. If $\frac{1}{2}$ of a ton of each be mixed, what weight of bone dust, phosphate of lime, and light loam will there be in the compound?

547. A cargo of 8000 bu. of corn, worth 60 cents per bushel, is insured at $\frac{3}{4}$ of $1\frac{1}{2}\%$ on $\frac{2}{3}$ of its value. If the cargo is lost, what will be the loss to the owner of the corn?

548. A New York wholesale grocer sells tea to a country merchant at a profit of 60%; the merchant is unsuccessful in business and pays only $37\frac{1}{2}$ cents on a dollar. What is the grocer's gain or loss per cent on the sale?

549. What was the total levy of a tax, whose net proceeds were $300,000, $4\frac{1}{2}\%$ having proved uncollectible, and $3\frac{1}{2}\%$ commission being paid for collection?

550. Find the duty at 15% on 350 bags of cinnamon, each bag containing 115 lbs. valued at 15 cents per pound.

551. A young lady received from her father's estate $20,000, so invested as to pay 3%. She sold this investment at $94\frac{1}{2}$, and bought bank stock at 225, paying $8\frac{1}{2}\%$ interest. What was the change in her income?

552. A merchant marked a piece of silk at \$1.50 per yard; this price was an advance of 25% on the cost. He sold at 15% discount on the price asked. What was his gain per cent?

553. Lorenzo James buys 86 A. 80 sq. rds. of land at \$80 per acre. With the proceeds of a note for \$8561.50 payable in 90 dys., discounted at 6%, he pays for the land and invests the remainder in horses at \$150.88 each. How many horses does he buy?

554. A grocer wishing to make cash purchases, borrows \$840.25 from a bank. For what sum did he give his note payable in 5 mos. 21 dys., at 6%?

555. A merchant had 3 six-month notes discounted at 5, 6, and 7% respectively. The proceeds of each were \$800. What was the face of each?

556. Find the cost per yard of cloth which was sold at the rate of 28 yds. for \$61.25, at a gain of 25%.

557. A farmer sold some sheep at \$5.25 each, thereby losing 12½%. For what price should they have been sold to gain the same per cent?

558. John Barlow bought 200 shares of railroad stock at 8¼% premium, with brokerage at ¼%, and other expenses \$4.75. What was the cost of the investment?

559. Find the premium on six \$1000 United States 6s, at 17½% above par.

560. Find the cost of a draft for \$240 payable 30 dys. after sight, interest at 6%, exchange 3% premium.

561. Find the value of 90 shares of Housatonic Railroad stock, at 4% premium.

562. What will be received for \$28,000 of Kentucky State bonds at 92, without allowance for brokerage?

563. Isaac Hopkins imported 25 bbls. of linseed oil, each containing 31½ gals., invoiced at 54 cents per gallon. Allowing 2% for leakage, what duty did he pay at 24% ad valorem?

564. What is the present worth of $8323.15 due in 3 mos., when money brings ¾% per month?

565. An insurance agent agrees to insure a store worth $12,000 for a sum sufficient to cover its value and the premium. Find the sum, the rate being 1%?

566. At 12% ad valorem, what duty must be paid on 50 hhds. of West India molasses, each hogshead containing 63 gals., invoiced at 36 cents per gallon, with an allowance of ½ % for leakage?

567. A broker received $6630 by selling $500 United States bonds, at 10½% premium. How many bonds did he sell?

568. A man owning 70% of a silver mine in Nevada sold 40% of his share for $7000. What was the value of his share, and the value of the whole mine?

569. Find the difference in rate of income between a 6% stock at 105, and a 6% stock at 75.

570. Thomas O'Neill bought 20 shares of 6% railroad stock at 107¾, brokerage ¼%. Required his yearly income from the stock.

571. Find the sum paid by Henry Brown who sent two pupils 118 dys. each to a district school supported by a "rate-bill," under the conditions given. Teacher's wages $400, fuel and other expenses $151.14; the public money received was $196, and the whole number of days' attendance was 3946.

572. When 5% bonds are bought at 83⅓, what is the rate of interest on the money invested?

573. Owen Glendower bought a 5% stock at such a rate as to secure 7% annually. What did he pay for it?

574. The proprietor of a hotel lost by leakage 10 gals. 3⅓ qts. from a cask of molasses containing 72 gals. Required his loss per cent.

575. How much will a Chicago broker invest out of $7872 for an Albany grain merchant, if he charges 2½% commission for buying?

576. For necessities of the first year in business, Ralph Seton borrowed of his sister $400 on the 4th of July, 1884. At 6% interest what amount was due June 1, 1885, the following payments having been made: Aug. 10, 1884, $72; Nov. 1, 1884, $45; Jan. 1, 1885, $200; Mar. 4, 1885, $50?

577. A ship was insured for $20,000, and its cargo for $10,000, at the rate of 30 cents on $100. What was the whole cost of insurance, $2 being paid for the policy?

578. The principal of a school bought an organ valued at $1000 on 3 mos. credit; after that period interest was to accrue at 7%. The purchase was made Jan. 1, 1882; he paid $400 Jan. 1, 1883. What was due April 1, 1883?

579. A bankrupt owing his creditors $16,682.50 paid them $3336.50. What per cent of their claims did they lose?

580. A store and its contents, insured for three-fourths of their united value, were burned. The owner lost $1200. What was his loss per cent, and what was the united value of the store and its contents?

581. Find the face of a draft that can be bought for $2000, exchange being at a discount of ½%.

582. What will be the face of a draft, payable 30 dys. after sight, that can be bought for $3000, exchange being ¼% premium, and interest 6%?

583. James Appleton gained $180 by selling 24 shares of mining stock which was bought at par. What was the selling price?

584. What amount will be invested in a mortgage for $4391 by an agent charging ⅞% commission?

585. A grocer, having sold crude naphtha at a profit of 75%, collected but ¼ of his bill from his purchaser who failed immediately after the conclusion of the sale. What was the grocer's gain or loss per cent?

586. How many shares of Michigan Central Railroad stock at 80 can be bought for $4427.50, brokerage ¼%?

587. 300 is 100 per cent more than what number? 300 is 90% less than what number?

588. James Stirling received $1700 on a claim of $2500 against a bankrupt estate. What per cent was paid? With liabilities amounting to $190,000, what were the assets?

589. What investment in California 8% bonds at 95 will yield a semiannual income of $1500?

590. Find the interest at 6% on $2800 for the month of July, reckoning 365 dys. to a year.

591. A gentleman gave 20% of a tract of land to his daughter, 10% to his son, and the remainder to his wife. What was the wife's share, the tract containing 363 A. 126 sq. rds.?

592. Find the principal which, placed on interest for 3 yrs. at 10%, will amount to $2970.50.

593. A butcher received from a bankrupt customer $154.16, which was 40% of the amount due. What was the amount due?

594. A wholesale druggist marked his goods at 90% above cost, but to a friend beginning business he sold them at 40% and 5% discount. What per cent profit did he make?

595. How many $100 bonds at 5% premium can be bought for $8400?

596. Find the cost in New York of 270 t. of Russia railroad iron, invoiced at $50 per ton, on which there was a duty of 24%.

597. A grocer bought 40 bu. of potatoes at 75 cents per bushel, and 160 bu. at 65 cents per bushel. What price per bushel must he ask for the whole lot in order to clear 20% by the transaction?

598. The cost of constructing a railway is $10,000,000, of which 40% is borrowed at 6%, and the remainder is held in shares. What must be the average weekly receipts in order to pay 5% dividend per annum, the working expenses being 65% of the gross receipts?

599. The customs revenue of the United States for the fiscal year ending July 1, 1885, was $181,471,939. The expenses of collecting it amounted to $6,494,847. What per cent was the expense of collection of the whole amount?

600. The proprietors of a certain boot and shoe factory say that 100 persons in their factory now make by machinery as many shoes as 500 persons formerly made working by hand processes. What per cent of the manual labor is displaced by the use of machinery?

601. A man and a boy can heel 300 pairs of shoes per day by the use of machinery. It required formerly 5 men per day to do this amount of work by hand. Reckoning the boy's labor as equivalent to half that of a man, what percentage of the former amount of labor has the use of machinery displaced in this case?

602. A certain furniture manufactory is now able by the use of improved machinery to make the same amount of goods as before with the labor of 77 men, whereas the number formerly employed was 110. What per cent saving in the cost of labor has the improved machinery effected for the owners of the manufactory?

603. By a hand-loom a weaver used to weave 70 picks of a certain kind of cotton per minute. A good power-loom will now weave 180 picks of the same kind per minute, and a good weaver can tend 4 looms. What per cent of labor for this purpose is rendered unnecessary by the use of power-looms?

604. A first-class workman can make 800 2-lb. tin cans per day by hand process. By the use of machinery he can make 2400. What decrease per cent in the manual labor required is here effected by the introduction of machinery? How many hands would be required to turn out 96,000 cans per week (i) by hand process, (ii) with the aid of machinery?

605. At a coal mine in the Hocking Valley, Ohio, it is estimated that mining machines, employing 160 men, produce as much coal as 500 men would produce, working by hand for the same number of hours. What per cent of labor have the machines displaced?

606. Will 25 negroes or 18 white men do a certain piece of work the quicker, supposing the whites 40% quicker workers than the negroes?

607. The amount of wheat in hundredweights, imported into Great Britain and Ireland from the United States and from India for the years 1883 and 1884, was as follows:

Date.	*From the United States.*	*From India.*
1883,	36,128,761	14,193,763
1884,	22,641,050	21,001,412

Express in percentage form (i) the falling off for the United States, (ii) the increase for India.

608. The quantities of wheat and of corn exported from the United States for 1880 and for 1885 were as follows:

Year.	*Wheat.*	*Corn.*
1880,	153,252,795 bu.	98,169,877 bu.
1885,	84,653,714 "	51,834,416 "

Find the decrease per cent in the exportation of each of these products in 1885 as compared with 1880.

609. The values of the exports from the United States for the years 1884 and 1885, collected under the three heads of agriculture, manufactures, and mining, etc., were as follows:

Year.	*Agriculture.*	*Manufactures.*	*Mining, etc.*
1884,	$536,315,318	$111,330,242	$77,319,293
1885,	530,172,966	117,259,810	79,250,170

Express these values as percentages of the whole exports for each year.

610. The amount of specie in the United States treasury on Sept. 30, 1878, and on Sept. 30, 1885 was as follows:

Date.	*Silver dollars.*	*Other silver coin and bullion.*	*Gold coin and bullion.*
1878,	$12,155,205	$15,777,937	$136,036,302
1885,	165,483,721	27,558,016	251,251,114

Compute for each year the per cent which the silver and the gold, respectively, form of the whole amount.

611. What per cent must be added to the numerator of $\frac{12}{145}$ to make the fraction equal to $\frac{27}{29}$?

612. A man having \$250 paid 6% of it to another man having \$300. How much per cent is the latter sum increased?

613. Simplify $\dfrac{\frac{1}{12} \text{ of } 16\frac{4}{7} - 1}{\frac{1}{16} \text{ of } 12\frac{4}{7} + 1} \div \dfrac{5\frac{5}{16} - 4\frac{7}{48}}{1 + \frac{1}{7} \text{ of } 12\frac{3}{5}}$.

614. A man owning 10 shares of 3% stock sells it at \$74 per share. With part of the proceeds he buys enough 5% stock at 105 to yield the same income that he received before. How much money has he remaining?

615. Two fields together have an area of 2 A. One of the fields contains 60 sq. rds. more than the other. What is the value of each field at \$80 per acre?

616. Simplify $\frac{9}{11}$ of $\dfrac{\frac{41}{162} - \frac{9}{49} - \frac{3}{54}}{\frac{4}{9} + \frac{1}{2} - \frac{13}{14}} \times (4\frac{2}{5} - 2\frac{1}{2} + \frac{3}{10})$.

617. The value in round numbers of the merchandise imported into the United States for the fiscal year 1882 from Great Britain, France, Germany, and Cuba was as follows: Great Britain, \$196,000,000; France, \$89,000,000; Germany, \$56,000,000; Cuba, \$70,000,000. What per cent of the imports from Great Britain were the imports from each of the other countries?

618. By selling goods at \$1173.92 a merchant gained 15%. What was his gain, and what did the goods cost him?

619. If to 336 lbs. of sugar 14 lbs. of sand were added, what would be the percentage of sand to the sugar and to the whole mixture?

620. A is 45 yrs. old. B is older than A by 12% of A's age. Find B's age, and express the difference of their ages as a percentage of B's age.

621. If a long ton (2240 lbs.) of ore produce 27 oz. Troy of pure silver, what is that per cent? How much ore must be raised to produce \$30,240 worth of silver, when silver is worth \$1.12 per oz.?

622. A man bought some cranberries for \$30, and sold $\frac{1}{3}$ of them at a loss of 10%. For how much should he sell the remainder to gain on the whole 20%?

623. Four reapers, working together, reap 50 A. of rye in 23 dys. They are paid at the rate of \$4.50 per acre, but they employ during the whole period 2 binders to aid them, paying each of them \$1 per day. If the first reaper was absent 3 dys., and the second reaper 1 dy., what sum of money should each reaper receive for the job?

624. A wine merchant paid \$182.07 for a pipe of wine containing 102 gals. He put the wine in bottles such that 3 bottles hold just 2 qts. of wine. The bottles cost him \$3.50 per hundred, and the corks 52 cents per hundred. For what price must he sell the wine in order to make a profit of 20 cents per bottle, and what will be his profit per cent?

625. The hop acreage in England amounts to about 70,000 A. What is the difference between the value of a good crop of 10 cwt. to the acre at \$25 per hundredweight, and a blighted crop of 2 cwt. to the acre at \$50 per hundredweight?

626. Find the change in income due to transferring \$27,216 $4\frac{1}{2}$% stock at $83\frac{1}{8}$ to $5\frac{1}{2}$% stock at $94\frac{3}{8}$, a brokerage of $\frac{1}{8}$% being charged on each transaction.

627. If \$19,200 in 3% United States bonds at $100\frac{7}{8}$ are transferred to a 4% railway stock at $110\frac{7}{8}$, the expense of the charge being \$74.59, what alteration in the income is the result?

628. Dry chestnut wood weighs 2320 lbs. per cord. 4 lbs. of the wood will yield 1 lb. of charcoal, and 20 lbs. of the charcoal make 1 bu. If the wood is worth $6 per cord, and 67 cents per cord is allowed for making the charcoal, what is the value of a basket of charcoal holding 2 bu.?

629. Find (to two decimal places) the population to the square mile in each of the following states: Massachusetts, New York, Ohio, Texas. (For data, see page 4.)

630. Of an electric cable $\frac{1}{13}$ rests on the bottom of the sea, $\frac{1}{15}$ hangs in the water, and $234\frac{2}{3}$ yds. are employed on land. What is the length of the cable?

631. If it cost $\$3.87\frac{1}{2}$ to carry $15\frac{1}{2}$ cwt. 60 mi., how far ought $3\frac{1}{4}$ cwt. be carried for the same money?

632. Two ships leave a harbor at the same time for the same port, distant 1200 miles; the faster vessel averages 10 miles an hour, and arrives at the port a day and a half before the other. What will the latter vessel average an hour?

633. Find the present worth of $1000 due in 315 dys. at 4%.

634. Find the interest on $2938.25 at $3\frac{1}{2}\%$ for 200 dys.

635. A farmer was offered 60 cents a bushel for 400 bu. of potatoes. He declined the offer, and soon after they fell 20% in value. What did he lose by keeping them?

636. A man sold a horse for $384, and thereby lost 4%. For what should he have sold him to gain 15%?

637. A grocer bought 20 chests of tea, each containing 42 lbs., for $18 a chest, and sold the tea for 60 cents per pound. What was his total gain, and what was his gain per cent?

638. If a salesman lose 15% by selling shoes at \$2.55 a pair, what must he ask for them in order to make 15%?

639. Simplify $2\frac{3}{7}$ of $\dfrac{15\frac{1}{2}-7\frac{3}{4}}{17\frac{1}{7}-14\frac{5}{28}} \div \frac{47}{88} + \dfrac{5\frac{4}{5}}{7\frac{1}{5}-6\frac{3}{5}}$.

640. If the ore of a mine yield 250 lbs. of metal for every 4 tons of ore, what is that per cent?

641. How much metal should 15 tons of ore yield to make the return 12%?

642. A man sells \$9600 stock at $94\frac{7}{8}$, and on the price of the stock rising to $95\frac{1}{2}$ he sells \$4800 more; afterwards, when the price had risen to 96, he buys back \$14,400 stock. What did he gain or lose by the transaction?

643. A certain piece of work can be done in 5 hrs. by a man, in 8 hrs. by a woman, and in 12 hrs. by a child. In what time can they do it working together?

644. A lamp burns half a cent's worth of oil per hour. What was the expense of using the lamp from Oct. 1, 1884, to Mar. 10, 1885, 4 hrs. and 40 min. each evening?

645. Simplify $\dfrac{2\frac{1}{2}-1\frac{1}{3} \text{ of } 2\frac{1}{4}+1\frac{7}{9}}{(2\frac{1}{2}-1\frac{1}{3}) \text{ of } (2\frac{1}{2}+1\frac{7}{9})} \times \dfrac{\frac{2}{11}+\frac{1}{9}}{\frac{4}{7}-\frac{3}{11}}$.

646. In an examination, the maximum mark for which was 1000, A got 680 marks, and B got $10\frac{1}{2}$% more than A. What was B's mark, and what percentage were A's marks of B's marks?

647. A regiment consisted of 800 men. If 3% are killed, 15% wounded, and 27% on the sick-list, how many are still fit for duty?

648. A can do a piece of work in 25 dys., B in 20, C in 36. A and B work together for 4 dys., and then B and C for 6 dys. How much of the work remains to be done?

649. Find the difference between the greatest and the least of the following fractions: $\frac{8}{7}$, $\frac{9}{16}$, $\frac{11}{21}$, $\frac{23}{36}$.

650. Simplify $\dfrac{13\frac{2}{3}-(3\frac{1}{5}\times 2\frac{1}{4})}{14\frac{2}{7}-(8\frac{1}{6}\times 1\frac{1}{7})} \div 7\frac{6}{13}$.

651. Which are the cheaper, eggs at 7 for 24 cents, or at 43 cents a dozen? How much would be gained by buying 672 eggs at the lower rate, and selling them at the higher rate? What would be the gain per cent by buying them at the lower rate, and selling them at 4 cents each?

652. How much lead must 1400 lbs. of lead ore yield to make the return 15% of the ore?

653. There are three cities, A, B, C. The rainfall at A is 25% greater than that at B, and that at B $14\frac{2}{7}$% greater than that at C, which is 21 in. Find that at A and B.

654. If 5 cu. ft. of air consist of 4 cu. ft. of nitrogen, and 1 cu. ft. of oxygen, express the percentage of oxygen to air, and of oxygen to nitrogen, in a cubic foot of air.

655. A skating rink is illuminated by 54 gas jets which are turned on at 5.15 P.M., and put out at 11 P.M. The price of gas is $2.25 per thousand cubic feet, and each jet consumes 12 cu. ft. per hour. What is the cost of illuminating the rink for the month of January, if the month begins on Friday, and the rink is open every evening except Sunday?

656. A man has an orchard covering $5\frac{1}{4}$ A., and each acre contains 36 apple-trees. One season the average yield per tree was 14 bu. of apples. These were made into cider, 8 bu. of apples yielding 1 bbl. of cider holding 36 gals. The man sold the cider for 11 cents per gallon, after reserving 4 bbls. for his own use. How much did he receive for the cider?

657. A lead mine yields 1 lb. 1 oz. of lead to 85 lbs. of ore. What is that per cent?

658. If 17 qts. of wine costing $1.40 per quart are mixed with 30 qts. of wine costing 95 cents per quart, and the mixture is sold at $1.50 per quart, what profit is realized?

659. For sewing water-proof hats, girls in Boston now (1884) receive $1 for 6 doz. If a girl can sew 8 hats in an hour, how much can she earn in a day of 10 hrs.? In a year of 304 working days? How much would she earn in a year at the old rate, which was 30 cents a dozen?

660. A good cutter in a Parisian butcher-shop can earn 8 frs. a day, and in Paris the butcher-shops are closed only one day in the year, Good Friday. How much can the cutter earn in 1 yr.? Take 1 fr. = $0.193.

661. If the charge of carting 1 t. of stone 1 mi. is 75 cents, what will it cost to carry 360 t. a distance of 800 yds.?

662. A bookseller buys 68 copies of a book at $3.25 each, and sells them at $3.75 each. What does he make, if for each dozen copies purchased by him one copy is thrown in free of cost?

663. If 100 lbs. of green coffee yield 91½ lbs. of burnt coffee, and the burnt coffee is worth $37.50 per 100 lbs., what is the value of the green coffee per 100 lbs.?

664. 1 bu. = 2150.42 cu. in. 1 gal. = 231 cu. in. How many gallons are there in 1 bu.?

665. The consumption of coal in Great Britain rose in a certain year from 92 millions to 97½ millions of tons. State this increase as a percentage to two decimal places, and find what the consumption would be in the next year, at the same rate of increase.

666. If a journey take $3\frac{1}{2}$ hrs., travelling 35 mi. per hour, how much must the rate be increased to save 42 min.? What per cent must the rate be increased?

667. The population of a town was 87,640 at one census, and 100,000 at the next census. Express the per cent of increase to three decimal places.

668. A horse is bought for \$343, and sold for \$371. What is the gain per cent? At what price should it have been sold to gain 12%?

669. A man bought a lot of 3 A. 135 sq. rds. at \$880 per acre, and spent \$7617.50 in erecting a house and outbuildings. He then let the premises for \$715 a year. What rate per cent did he get on his investment?

670. If in 15 min. a vessel receives by one pipe 22 gals. 3 qts. of water, and loses by another pipe $3\frac{1}{3}$ gals., how much water will the vessel contain at the end of an hour and a half?

671. Simplify

$$3.28167 + 0.0004193 + 3.8961028 + 0.8218.$$

672. Find the simple interest on \$81,176 for 120 dys. at $4\frac{1}{4}\%$.

673. What is the simple interest on \$2962.50 from Dec. 30, 1887, to Mar. 12, 1888, at 4%?

674. The marks for perfect answers to the questions on an examination paper being 6, 6, 10, 10, 6, 10, 10, 8, and a boy having obtained the marks 4, 5, 7, 9, 3, 10, 0, 6, respectively, find what per cent of the mark for the whole examination he has obtained.

675. What sum of money, at 5% simple interest, will produce in 2 yrs. the same amount of interest as \$2160 at 4% in 3 yrs.?

676. By selling out 3% bonds at $102\frac{3}{4}$, and investing the proceeds in a railway stock at 137, a man finds that he can double his income. What is the annual dividend of the railway stock?

677. What sum of money, lent at 4% per annum simple interest, will produce in 3 yrs. the same amount of interest as \$2592 lent at 5% will produce in 2 yrs.?

678. A gas factory uses a coal which yields 10,500 cu. ft. of gas per ton. The loss in purifying and by leakage is $\frac{1}{15}$. The factory has to supply 100,000 cu. ft. of gas daily. The cost of the coal is \$4.90 per ton. How many tons of coal are consumed each day? How much per 1000 cu. ft. must be the price of the gas, in order that the gross daily profit may be \$100?

679. A teamster carries 4 loads of gravel daily from a gravel pit to a railroad line $2\frac{3}{4}$ mi. from the pit, and each load contains $2\frac{1}{2}$ cu. yds. of gravel. He is paid at the rate of 35 cents for carrying 1 cu. yd. one mile. How much will he receive for carrying 500 loads, and how many days will it take him to carry them?

680. Simplify $\dfrac{2\frac{3}{4} + 2\frac{1}{2} \text{ of } \frac{7}{3\frac{4}{5}} - \frac{1\frac{4}{5}}{2\frac{1}{2}}}{2 - \frac{1}{2}\frac{5}{2}\frac{1}{8}}$.

681. The sum of \$2500 is to be raised by a tax in a certain town. The assessed valuation is \$850,000, and there are 300 polls, each taxed \$1.25. Find the rate per \$100, and the tax of a man who is assessed \$4480 and pays 2 polls.

682. A city hall, in a city whose assessed valuation is \$4,000,000, was built at a cost of \$57,000. The money was raised by direct taxation, and the expense of collection was 5%. What was the rate per \$100, and what sum did a man pay whose property was valued at \$50,000?

683. The distance between two stations, A and B, was measured with a 10-ft. pole, and found to be 3430 ft. The pole was afterwards found to be long by $9\frac{3}{8}$ in. What is the true distance from A to B?

684. On Mar. 4, 1885, the assets of the United States treasury amounted to $210,663,621.15, and the liabilities to $201,899,031.04. On Nov. 1, 1885, the assets were $259,437,431.25, and the liabilities $192,619,138.87. How much surplus balance was in the treasury Nov. 1, and what was the increase between the two dates?

685. In 1884, the quantity of sugar produced in the United States was 287,712,230 lbs., while the quantity imported was 2,756,416,896 lbs. The quantity exported that year was 85,532,916 lbs. How much sugar remained for consumption, and what per cent of the amount consumed was produced in the United States?

686. For the fiscal year ending June 30, 1885, the value of the sugar and molasses imported into the United States was estimated at $73,517,063. The duty collected thereon amounted to $52,184,744. Find (to the nearest unit) the average ad valorem rate of duty on these two articles.

687. For the fiscal year ending June 30, 1885, the value of the dutiable merchandise imported into the United States was (in round numbers) $387,000,000, and the value of the merchandise imported free of duty was $193,000,000. The amount of duty collected was $178,000,000. Find (to the nearest unit) the average ad valorem rate of duty, (i.) on the dutiable merchandise; (ii.) on *all* the merchandise.

688. A county jail is to be built at a cost of $16,800. The money is to be raised by a tax assessed on property valued at $1,400,000. What rate will cover the cost of the jail, and the collector's commission of 4%?

689. A lady received $1517.40, the amount due on a note which had been on interest at 8% for 1 yr. 6 mos. 18 dys. What was the face of the note?

690. On an invoice of body Brussels from London, the duty was $174. What was the rate, the cost of the carpet being $2175?

691. Find the difference between the true discount and the interest of $600 for 2 yrs. 6 mos., at 8%.

692. For supplying a town with water a tax of $34,500 is assessed. There are 100 polls taxed $1.50 each; the real estate of the town amounts to $1,700,000, the personal property to $500,000. What is the rate of taxation?

693. Find the rate per cent when $2700 worth of New Jersey Central Railroad stock pays $243 dividend.

694. A Pennsylvania Petroleum Co., assessed the stockholders 15%. What was paid by a director who owned 70 shares?

695. To secure an annual income of $2100, how much must be invested in South Carolina 6s at 80?

696. A Florida land agent received $636 for investment. With commission at 6%, how many $50 lots can he buy for this sum?

697. The proprietor of a clothing store in Boston sent a note of $5000 to a lawyer in New York, with directions to secure upon it what he could from the maker of the note, who had gone into bankruptcy. The lawyer secured 62½% of the note, and charged 5% commission. What sum did the merchant receive?

698. At 10% discount how many $1000 Northern Pacific Railroad bonds can be purchased for $21,600?

699. A commission merchant paid over to a grocer $366.72, the net proceeds of a month's sale of peaches. Find the gross receipts and the quantity of peaches sold, rate of commission being $4\frac{1}{2}\%$, and the price of the peaches being 60 cents per peck.

700. For how much must a 3-mos. note, without interest be made, that when discounted at 9% it may yield $1000?

701. A stockholder in a gas company paid $42.25, his share of a $3\frac{1}{4}\%$ assessment for extra expenses. How many shares did he own?

702. A commission merchant purchases coal with the residue from $441, when 5% commission has been deducted. How many tons at $7 can he buy?

703. How much below par is a stock when 65 shares of it can be bought for $5200?

704. What amount must be invested in Virginia 6s at 90, to realize an income of $3600 annually?

705. A gentleman wishes to secure to his wife an income of $1680. To realize this sum what amount must be invested in 6% stocks 5% below par?

706. A bank with a capital of $240,000, in 6 mos. has accumulated $14,770 net, and after declaring a semiannual dividend of 5%, reserves the remainder for surplus. What is the surplus and the dividend on 25 shares?

707. Find the yearly income from $4214 invested in five per cents, bought at 98.

708. A sheep farmer in Texas sold his wool for 26 cents per pound, and thus realized $8\frac{1}{3}\%$ over expenses. Had he sold the wool at 22 cents, what would have been the loss per cent?

709. A young farmer having received $3420 from his grandfather's estate, invested the money in a 6% stock purchased at 95. What yearly income was received?

710. With brokerage ¼%, how much stock at 104¾ can be bought for $5250?

711. A Colorado land agent charged $57.825 for the purchase of 257 A. of land at 4½% commission. What was the price per acre?

712. To secure an annual income of $3720, what sum must be invested in five per cents at 98¼ with brokerage ¼%?

713. The owner of pine forests in Georgia shipped from Savannah to New York a quantity of turpentine worth $1.75 per gallon, to the amount of $224. By leakage 8 gals. were lost. For what price per gallon must the remainder be sold that there may be an advance of 25% on the cost?

714. What per cent of unlawful gain will be made when 14 oz. are sold for 1 lb.?

715. What draft may be purchased for $487.20 when exchange is at 1½% premium?

716. Find the cost of a draft on Albany for $800, payable at sight, with exchange at a premium of ¾%.

717. In a town whose real estate is valued at $246,500, and the personal property at $88,500, and in which there are 506 polls paying 75 cents each, the sum of $2054.50 is to be raised by taxation. Find the tax of B. J. Ingersol, owning property, real and personal, to the amount of $3000, and paying for 2 polls.

718. A Maryland peach dealer invested $2397.50, the net proceeds of one summer, in five per cents at 87%, brokerage ½%. What yearly income will he receive?

719. A library and library building were insured on $\frac{3}{5}$ of their united value for $302. Find the value of the books and the building, the policy costing $2, and the rate being 75 cents on $100?

720. At an agricultural store, a reaper which cost $40, was sold for a sum that gave the maker 128% profit, and also 5% commission to the agent. What was the selling price?

721. A druggist bought quinine at 10% discount from net price, and sold it at $18 per pound, which was 25% more than he paid. Find the net price.

722. A New Orleans merchant sent to his agent in Chicago $2000. What was the cost of the draft, exchange being 3% premium?

723. Find the face of a draft that can be bought for $158.40, exchange being at 1% discount.

724. A lumber-dealer, by the wreck of a vessel, lost $\frac{2}{3}$ of a cargo of 84,780 t. of white oak. What per cent must be advanced on the cost price, that he may lose nothing?

725. A lady in Illinois inherited 45% of a lead mine, and from it received an income of $7200. Her brother owned 36% of the same mine. What was the brother's income and the value of the mine, the earnings being 16% of the cost of the mine?

726. An upholsterer bought 70 bales of curled hair at $36 per bale, but found 10 bales so injured that he sold them at 15% discount. At what price per bale must the rest be sold to secure an advance of 20% on the purchase?

727. A lawyer charging $1\frac{1}{4}$% for making safe investments, receives from one of his clients $27,684.14 for the purchase of Pacific Railroad stock. What amount of stock will he send to his client?

728. A lady had property insured to the amount of $2000 in a mutual insurance company. Upon renewal she received a dividend of $12.50. The premium was $25. What per cent of the premium was the dividend? What was the rate of insurance?

729. Samuel Eliot had a farm of 218 A. yielding a rent of $1362.50. He sold the land for $125 per acre, and through a broker invested the proceeds in New York six per cents at 108¾%, with brokerage ¼%. What was the change in the yearly income?

730. The charges of an agent who purchases grain are 3% commission, and 1½% additional for guaranteeing prompt delivery. How much money must be sent to him in order that, after deducting his fees, $9000 may be left with which to buy grain?

731. What amount of duty must be paid on plain china ware valued at $2540, on which the rate is 55% ad valorem, and 500 boxes of window glass, each containing 50 lbs., on which the rate is 2⅞ cents per pound?

732. For renting a house and securing payment, the charge of an agent amounted to $56.275, of which sum $23.75 were costs, and the remainder the commission of 5% on the rent paid. Required the rent.

733. Jones, Jenkins & Co. import from Liverpool 80 pieces of pongee silk 40 yds. each, valued at 3*s.* per yard, duty 50%; 1000 yds. hair-cloth at 4*s.* per yard, duty 50%; 500 yds. cretonne at 2½ *s.* per yard, duty 35%; and Irish linen worth £30, duty 40%. Find the whole amount of duty, allowing $4.86 to the pound sterling.

734. How much 5% stock at 120 must be bought to yield an income of $720, and what will it cost?

735. Isaac Ives sent to New Orleans 160 bbls. of lime to be sold at $6.25 per barrel, by an agent, on a 3% commission for selling. The agent paid $5.75 for cartage, and deducting 1½% for investing, bought 50 bbls. of sugar with the proceeds. What was the cost per barrel of the sugar?

736. A florist insured his greenhouses and stock, together valued at $8000, for ⅝ of their value, at 2%; they were injured by fire to the amount of $6000. Find the florist's loss, including his premium, and the loss of the insurance company.

737. A New Orleans merchant paid $61.44 for duties at 24% ad valorem, and $20.48 for other charges on 16 pieces of linen containing 32 yds. each, imported from Dublin. What was the invoice value per yard, and the cost per yard, after the payment of duties and other charges?

738. A merchant paid $46.25 for insuring the cargo of a ship at ¾% on ⅝ of its value. What was the entire value of the cargo?

739. A note for $151.74, under date of Nov. 1, 1878, had four indorsements; viz., April 5, 1879, $20; May 20, 1881, $6.20; Sept. 4, 1881, $11.84; Jan. 1, 1882, $80. What balance was due Oct. 7, 1882?

740. If $20,500 be invested in 6% stock at 102½, what will be the yearly income? What would be the yearly receipts, were an equal sum invested in 5% stock at par?

741. A Patterson silk manufacturer sent to his agent in Canton to buy 2500 lbs. of raw silk at $17 a pound. With an allowance of 3% for the agent's commission, and $315 for other charges, what must be the face of the draft forwarded to Canton?

742. At $7\frac{3}{10}$% what time will be necessary for $1500 to gain $228.12½?

743. The agent for a St. Louis wholesale grocery receives 6% on the sums received from his sales, and 4% additional at the end of the year on the net profits. His sales for the year were $30,456.50, and the net profits $10,642.35. What was his commission?

744. A lady invested for her daughter $512.50 at compound interest at 8%, when the young lady was 17 yrs. 5 mos. 9 dys. old. What amount will be due at the completion of the daughter's twenty-first year?

745. A judge of probate has the care of an orphan's property valued at $4890. Will a better income be secured by investing this money in a 5½% stock at 81¼, with brokerage at ¼%, or in real estate paying 7%?

746. A coal dealer, through an agent charging 3% commission, sent to Scranton for 5000 t. of coal. At $4.25 per ton, and with $157.50 for freight, what will be the gross outlay for the coal?

747. Find the rate at which $75 will amount to $144.80, from June 6, 1870, to May 12, 1881.

748. A farmer sold some land, whose value had been injured by the erection of a dam over a stream, at a loss of $1200, which was 10% of the cost price. What sum did the farmer pay for his land?

749. A father having received $\frac{8}{11}$ of an estate, transferred ⅛ of the legacy to his son, whose tax on the property, at the rate of 2½%, amounted to $5.50. Find the value of the whole estate.

750. Clark & Crane, wholesale grocers, sent to San Gabriel, Cal., for 3500 lbs. of grapes, invoiced at 8½ cents per pound, and 2½% on the invoiced price to the commission merchant. Find the sum paid by the grocer.

751. A cargo of cotton was insured for \$40, the rate being $\frac{1}{8}$ of 1%. What was the value of the cotton?

752. Seth Mapes of Boston sent \$10,246.50 to his agent in Chicago for the purchase of 1800 bbls. of flour, the agent's commission being $3\frac{1}{2}$%. What price per barrel was paid for the flour?

753. A government clerk bought a small house in Georgetown for \$1728, giving his note and a mortgage on the house. The note was dated Jan. 1, 1884, at 6%. What was due Dec. 11, 1884, the following payments having been made? Mar. 1, 1884, \$300; May 16, 1884, \$150; Sept. 1, 1884, \$270; Dec. 1, 1884, \$135.

754. A commission merchant, for selling wool at 32 cents per pound, is paid a commission of $2\frac{3}{4}$%, amounting to \$235.40. How many pounds were sold?

755. A miller insures 2400 bbls. of flour worth \$8 a barrel at their full value, at $\frac{1}{4}$%. Only 900 bbls. are saved from a destructive fire. What will be the actual loss of the company? What premium will the merchant pay, and how much will he receive from the company?

756. \$1600. BOSTON, May 17, 1874.

For value received, on demand, I promise to pay George Slow sixteen hundred dollars with interest. AMMI JOHNS.

Indorsements: Feb. 20, 1877, \$228.64; Aug. 8, 1877, \$70; May 16, 1878, \$850.86; Oct. 4, 1878, \$24.

What was due Sept. 1, 1880?

757. What is the difference between the true discount and the interest on \$1600 for 90 dys. at 7%? Between the bank discount and the true discount?

758. At $122\frac{1}{2}$, how much stock can be bought for \$19,293.75?

759. A note dated May 3, payable Nov. 3, and discounted at 6%, yielded $730. What was the face of the note?

760. A teacher 30 yrs. old insures his life for $15,000. What annual premium will he pay at the rate of $23.023 on $1000?

761. When $17,500 are the net earnings of a company with $240,000 capital, what rate of dividend will be declared, with a reservation of $1500 for contingencies?

762. If a $7\frac{3}{10}\%$ stock be bought at $8\frac{3}{4}\%$ discount, what rate of income will it pay?

763. What annual income will accrue from a 6% stock bought at $94\frac{3}{4}$, brokerage being $\frac{1}{4}\%$, sum invested $28,500?

764. A Quincy merchant paid his agent in New York $16.30 for selling wheat at $1.63 per bushel on a commission of $2\frac{1}{2}\%$. How many bushels were sold?

765. What is received for 116 shares of stock at 110, $\frac{1}{4}\%$ being paid for brokerage, and $3.78 for telegrams?

766. When bank stock pays a dividend of 5%, how many shares will furnish an income of $750?

767. Jeremiah Peirce imported 100 gross of Florence oil, valued at $1.20 per dozen. If $2\frac{1}{2}\%$ were allowed for breakage, what duty was paid at 12%?

768. A captain paid $83.50 for the insurance of $\frac{2}{3}$ of a fishing schooner at $2\frac{1}{2}\%$, the cost of the policy, $1, being included. What was the whole value of the schooner?

769. George Peirce having invested $15,000 at par in Georgia 7s, sells at 15% discount. What will he receive if he pay $\frac{1}{2}\%$ for brokerage, and $2.78 for other expenses?

770. What is the rate when $1250 dividend is paid on 100 shares of Boston and Albany Railroad stock?

771. Which investment will secure the better income, bank stock paying 10%, at 234½, or railroad bonds paying 3%, at 92½?

772. $1240. SYRACUSE, N.Y., Nov. 1, 1882.

On demand I promise to pay Simon Phelps, or order, twelve hundred and forty dollars, with interest, for value received. HENRY SHORES.

Indorsements: Received Oct. 6, 1883, $122.14; Mar. 4, 1884, $178.06; Dec. 11, 1884, $215.54; July 20, 1885, $401. Find amount due Oct. 15, 1885.

773. A bankrupt's assets are $675. By a special arrangement with his creditors, he pays 75% on half his debts, and 60% on the other half. What is the amount of his debts?

774. Stephen Fitch sold a house and lot, with the proceeds of which he bought 12 Illinois State bonds of $500 each, at 12% premium, brokerage ¼%. What were his receipts from the sale?

775. A country merchant bought three pieces of carpet, 190 yds. in all, for $380. Thirty yards were unsalable, and he disposed of the rest at 15% advance on first cost per yard. Did he gain or lose, and how much?

776. Robert Cheney sold (without a broker) $50,000 of railroad bonds at 93¾%, and invested such a sum in United States 6s, at 109¼, as was necessary to yield an annual income of $1920. How much money remained for the purchase of a house?

777. At what price must 6% stock be bought, to yield 7½% on the investment?

778. $1975.50. LYNN, Jan. 11, 1883.

For value received, on demand two months after date, I promise to pay Alice Dunn nineteen hundred seventy-five dollars fifty cents, with interest after two months at 6%.

GEORGE GEITH.

Indorsements: May 1, 1883, $600; June 5, 1883, $800; Sept. 25, 1883, $300. What is due Dec. 13, 1883?

779. George Thomas invested in four per cents, bought at such a price that he realized 3% income. What did he pay for them?

780. A collector, receiving $\frac{1}{4}$% commission, was paid $56.25 for collecting taxes. What sum did he put into the town treasury?

781. A butcher bought 160 lbs. of meat for $9.60, and sold $\frac{3}{8}$ of it at 8 cents per pound. At what price per pound must the remainder be sold to gain 56$\frac{1}{4}$% on the whole cost?

782. How much stock at 90 must be sold to pay for a legacy of $9000, on which is due a tax of 10%?

783. Find the balance due Feb. 3, 1884, on the account which follows:

ELI SHELDON, To AARON OKEY, *Dr.*

For lumber, labor, and board, $600, with interest at 6% after Jan. 1, 1877.

Five payments had been made; viz., Feb. 16, 1877, $100; April 16, 1877, $150; Dec. 24, 1879, $12.50; May 3, 1880, $7.50; Nov. 3, 1882, $200.

784. An agent, after deducting a commission of 5%, sent $2625.135 to his employer. What was the amount of the sales?

785. How much stock at 5% premium will pay for $6000 worth of stock at 8$\frac{1}{2}$% premium?

786. An Ohio grain-merchant received \$3694.95 to invest in corn, on a commission of $3\frac{1}{2}\%$. How many bushels, at 75 cents per bushel, were bought?

787. Find the value of a 6% stock paying $5\frac{1}{2}\%$ interest on the amount invested.

788. A sugar planter from Louisiana invested the net proceeds of a year's crop in a certain railroad stock, paying 4% semiannually. With the stock at $116\frac{1}{2}$, brokerage being $\frac{1}{2}\%$, what will be the yearly rate per cent of income, if 4% semiannually be considered the same as 8% per annum?

789. A dishonest dealer wishes to lower the price of his best quality of syrup. What per cent of water must be mixed with 45 gals. of syrup, at \$1.65, to reduce the price to \$1.35?

790. An owner of fancy cows finds his wholesale customers unwilling to pay 4 cents per quart, the cost price, for pure Guernsey milk; he therefore mixes so much water that he can sell the mixture at 3 cents per quart, and make 20% on his outlay. How much water is there in every quart sold?

791. If new-made soap sells for \$4.75 per hundredweight, and in drying loses 0.12 of its weight, what is a hundredweight of the dry soap worth?

792. A St. Louis broker invested \$10,000 in three per cents at 75, and when they rose to 78, he sold that stock, and bought bonds at \$208 which paid 8%. What was the change in income?

793. A druggist bought a stock of goods for \$1643.50 cash. For what sum must his note be made, payable in 90 dys., that, when discounted at 6%, the proceeds shall yield the amount required?

794. The sugar-beet yields 6% of its weight in sugar. One acre of land will produce 25,000 lbs. of beet-root, worth $2.75 per ton. How many acres of land are needed to supply with beet-root a sugar factory whose annual production of sugar is 100,000 lbs., and what is the value of the beet-root supplied?

795. Crystallized blue vitriol is composed of 63.3 parts, by weight, of copper, 32 parts of sulphur, 80 parts of oxygen, and 90 parts of water. Find its percentage composition. How much copper is there in 200 lbs. of blue vitriol?

796. Two coal-dealers in Pittsburg sold an equal amount of coal. One received from a Boston merchant $6200 on the delivery of the coal; the other took a note for $6800 for 2 yrs. 6 mos., without interest, from a New York banker. If money commands 7%, which dealer received the greater price for his coal?

797. $14,400 in 3% United States bonds at 101¼ are transferred into a 4½% railway stock at 125¼, the expenses of the operation amounting to $50.98. Find the alteration in the income produced.

798. Find the net cash amount of a bill of $750, discounts being ⅛, 25, and 17½, and an additional discount of 5% for cash.

799. A milkman gains $1401.60 in 1 yr. by selling milk at 8 cents per quart. He sells on an average 42 gals. daily. What is his rate of profit per cent?

800. A milkman gains $2102.40 in 1 yr. by selling milk at 8 cents per quart. He sells on an average 48 gals. of milk every day. What is his rate of profit per cent?

801. A man has a sum of money due him at the end of 4 yrs., simple interest being reckoned at 5%. What fraction of the sum could he take off for payment at once?

802. Three pipes carry water into a tank. The first running alone can fill it in 4 hrs., the second in 5 hrs., and the third in 6 hrs. How long will it take them to fill the tank if they run together?

803. A man has a bill for $1353.60 due him at the end of 4 yrs. Find what sum he could take for cash payment, simple interest being reckoned at 5%.

804. A vessel has a leak which admits $127\frac{2}{5}$ gals. of water in 3 min. The pumps are just able to remove $209\frac{1}{7}$ gals. in 5 min. Can the pumps keep the amount of water in the vessel from increasing?

805. A good harness oil is composed of $\frac{2}{3}$ suet, $\frac{1}{6}$ lard, $\frac{1}{3}$ turpentine, $\frac{1}{8}$ beeswax, and the rest olive oil. Find the cost of 1 lb. of this oil, if the suet costs 12 cents per pound, the lard 19 cents, the beeswax 45 cents, the turpentine $16\frac{1}{2}$ cents, and the olive oil $28\frac{1}{2}$ cents.

806. Reduce $\frac{18}{228}\frac{11}{46}\frac{24}{2}$ to its lowest terms.

807. If a loaf weighing $4\frac{1}{2}$ lbs. be sold for 6 cents when wheat is 72 cents per bushel, what should be the price of 150 lbs. of bread when 8 bu. of wheat bring $8.64?

808. One pipe can fill $\frac{2}{5}$ of a vessel in 1 hr. Another pipe can empty $\frac{3}{5}$ of it in 3 hrs. If the vessel be empty, and both pipes are opened, in what time will the vessel be full?

809. A clock which gains $7\frac{1}{2}$ min. in 24 hrs. is 12 min. fast at midnight on Sunday. What o'clock will it indicate at 4 o'clock on Wednesday afternoon?

810. At what point must the hands of a clock be placed at noon to indicate the true time at 7.30 P.M., if there be a daily gain of $3\frac{1}{2}$ min.?

811. A reservoir 10 ft. deep contains water to the height of 2 ft. It is supplied with water by a pump which could fill it if empty in $5\frac{3}{11}$ hrs. The water is taken from the reservoir by another pump, which is capable of emptying it, when full, in $9\frac{3}{8}$ hrs. If both pumps are set in action, in what time will the reservoir be completely full of water?

812. A steam pump, employed to raise water to a reservoir, will fill the reservoir in 10 hrs. 25 min. when it works well. One day the efficiency of the pump was reduced $\frac{1}{3}$ by an accident, just as the reservoir was $\frac{1}{4}$ full. How long did it take the pump on this occasion to fill the reservoir?

813. If \$480 amounts to \$648 in 10 yrs. at simple interest, what would \$24,000 amount to in 20 yrs. at the same rate?

814. A grist mill has 3 mill-stones. The first stone can grind 5 bu. of corn in 2 hrs., the second 10 bu. in 3 hrs., and the third 15 bu. in 4 hrs. How many bushels can all three grind in 1 hr.? How many hours will it take them to grind 460 bu.?

815. By selling out 3% bonds at $102\frac{3}{4}$, and investing the proceeds in a railway stock which pays an annual dividend of 7%, a man finds that he can double his income. What is the price of the stock?

816. A fountain can fill a fish basin in $2\frac{1}{2}$ hrs. Another fountain can fill it in 3 hrs. If the basin is dry, and both fountains are turned on, in what time will it be $\frac{3}{4}$ full? If the basin holds 15,000 gals., how many gallons will each fountain empty into it in 1 min.?

817. The weight of the water contained in a rectangular cistern 8 ft. long and 7 ft. wide is $93\frac{3}{4}$ cwt. of 112 lbs. each. What is the depth of water in the cistern if a cubic foot of water weigh 1000 oz.?

818. A ship 40 mi. from the shore springs a leak, which admits $3\frac{3}{4}$ t. of water in 12 min. 60 t. would suffice to sink her, but the ship's pumps can throw out 12 t. of water in an hour. Find the average rate of sailing, that she may reach the shore just as she begins to sink.

819. Two fountains empty into the same basin. The first can fill it in 3 hrs. and the second in 5 hrs. The first is allowed to play alone for 1 hr., and then the second for $1\frac{1}{2}$ hrs. Both fountains are then turned on. In what time will the basin be filled?

820. A certain district contains a rural population of 3789 and a town population of 2354. Among the rural population, the births are 31 per thousand annually, and the deaths 25 per thousand. Among the town population the births are 42 per thousand, and the deaths 30 per thousand. What is the annual increase or decrease of the whole population?

821. A dealer bought 2 horses, giving $\frac{4}{5}$ as much for one as for the other. He sold the more expensive horse at a gain of 15%, and the other at a loss of 5%, receiving \$715.20 for both horses. What did he pay for each horse?

822. In Fahrenheit's thermometer the freezing-point is marked 32°, the boiling-point 212°; in the Centigrade the same points are respectively 0° and 100°. Express 4° C. in Fahrenheit's scale, and 62° F. in the Centigrade scale.

823. A certain zinc ore yields 55% of metallic zinc, and a certain copper ore yields 25% of metallic copper. In making brass from these two metals 5% of the metal is wasted, and the coals and labor cost as much as the metal. The zinc ore is worth \$43.20 per ton, delivered, and the copper ore \$81.60. What is the net cost per ton of brass consisting of a mixture of equal parts of the two metals?

CHAPTER VI.

PROPORTION.

Miscellaneous Exercises

(illustrating the applications of the Rule of Three).

1. Find a fourth proportional to 3, 15, 7.

2. Find a number which has the same ratio to 21 that 45 has to 9.

3. A's wealth is to that of B as 3 to 7. B is worth $63,000. What is A worth?

4. In five years the population of a mining town increased from 200 to 16,000. If the rate of increase remain the same, what will the population be after five years more?

5. If 75 men can do a piece of work in 12 dys., how many men could do it in 20 dys.?

6. What must be paid for 12 lbs. of indigo, when 7 lbs. cost $12.75?

7. If twelve men reap a field in 4 dys., what time would be required for 32 men to reap it?

8. A ship performs a voyage in 63 dys., sailing at the rate of 6 knots an hour. How long would it take her if she sailed 7 knots an hour?

9. A milkman having failed, settled his accounts, and found he had property to the amount of $215, while he owed $1075. If his creditors demand immediate payment, how much will they receive on a dollar?

10. A gentleman gave to his daughter on her marriage $1500, which was $\frac{3}{7}$ the value of his interest in a silver mine. To his son he gave a sum equal to $\frac{4}{5}$ of the same investment. What amount was received by the son?

11. A bankrupt's debts are $2520, and his assets over and above all expenses are $1890. What can he pay on a dollar?

12. If 4 men reap a field in 6 dys., how many days will one man require for the same work?

13. An English clergyman pays an income tax of £6 12*s.* 6 *d.* on a £265 income. What is the tax on £1?

14. If $15.12 is paid for a bag of coffee weighing 56 lbs., what will 78 lbs. cost?

15. How many cabbages can be planted on 25 sq. rds. of land, each plant occupying 180 sq. in.?

16. If a train travel at the rate of 30 mi. per hour, how many feet does it pass over in a second?

17. A cow gives 2408 qts. of milk in a year. How many gallons will 57 cows give, at the same rate?

18. How much tea at 92 cents a pound must be given in exchange for 13 rugs at $6.90 each?

19. How many times can a three-peck measure full of corn be emptied into a bin which holds $8\frac{1}{4}$ bu., before it will be full?

20. If a wheel revolve 49,280 times in passing over 133 miles, what is its circumference?

21. A stable-keeper bought 288 bu. of oats. How long will they supply 8 horses, if each horse eats 6 qts. a day?

22. One of the wheels of a machine makes 91 revolutions in $3\frac{3}{4}$ sec. How many revolutions will it make in $5\frac{1}{4}$ hrs.?

23. How many dessert spoons, each weighing 2 oz. 3 dwt. 6 gr., can be made from 6 ingots of silver, each weighing 19 oz. 9 dwt. 6 gr.?

24. If a field containing an acre and a half produces 180 bu. of potatoes, what yield may be expected from an adjoining field which contains 5 A. 32 sq. rds.?

25. A spring of water which yields 250 gals. an hour supplies a town containing 360 families. What is the average daily supply for each family?

26. What is the circumference of a wheel which makes 31,680 revolutions in passing over 87 mi.?

27. If a dozen teaspoons weigh 10 oz. 12 dwt. 15 gr., how many can be made from an ingot of silver weighing 6 lbs. 5 oz. 19 dwt. 6 gr.?

28. Three men, A, B, C, put a certain sum of money into business. A put in $\frac{3}{8}$ of the sum, B $\frac{2}{5}$, and C the rest. In winding up the business, they found that the original sum had increased by exactly one-quarter, and now amounted to $60,500. Find each man's share of the profit.

29. A town in Massachusetts, divided into three school districts, pays a school tax of $4212. The property in District No. 1 amounts to $24,700; in No. 2, to $37,250; in No. 3, to $43,350. What school tax is paid by each district?

30. In 1880 the Austrian Lloyds possessed 72 steamers, having a total of 17,100 horse-power. What was the average horse-power per steamer?

31. At 6%, what will be the interest on $130 for 8 mos.?

32. A man bought a field containing 7 A. 4295 sq. yds., and divided it into equal lots, each containing 16 sq. rds. 25 sq. yds. How many lots were there?

33. In what time will \$150 gain \$37.50, interest at 6%?

34. Light travels 184,000 mi. a second. How long does it take it to travel from the sun to the earth, assuming the distance to be 92,600,000 mi.?

35. Provisions for 9 mos. have been furnished to a force of 2100 men. Before any of the provisions are used, a reinforcement of 600 men is received. How long will the supply of food last?

36. Find the value of $\frac{5}{8}$ of a ship, if $\frac{4}{9}$ of it is worth \$3264.

37. A man paid \$2 for the hauling of 1200 lbs. of coal 36 mi. At the same rate, how many pounds could be carried 24 mi. for the same sum?

38. How long would 4 horses be in eating 48 bu. 3 pks. of oats, at the rate of 6 qts. per day for each horse?

39. If $2\frac{1}{2}$ yds. of cloth cost one guinea, what must be paid for $183\frac{1}{2}$ yds. of the same material?

40. A man travels 540 mi. in 24 dys. by walking 6 hrs. a day. How many miles will he travel in 3 dys., if he walk 8 hrs. a day?

41. A young man in college spends \$15.40 of his allowance every 35 dys., and saves \$100 per year. What is his yearly allowance?

42. A professor at Oxford paid £15 7 *s.* 6 *d.* income tax at the rate of 6 *d.* to the pound. What was his income?

43. The shadows cast of objects at a given instant vary directly as their heights. If a staff 6 ft. high cast a shadow 7 ft. long, how high is a tree whose shadow is 112 ft. long?

44. If a tower 36 ft. high cast a shadow 48 ft. long, what is the height of a mast casting a shadow 288 ft. long?

45. If $\frac{2}{5}$ of $\frac{3}{4}$ of a cargo of raw silk be worth $4000, what will be paid for $\frac{7}{8}$ of $\frac{8}{15}$ of the cargo?

46. Seventy-two men dig a ditch in 63 dys. In how many days will 42 men perform the same work?

47. One dozen silver spoons, weighing $3\frac{3}{4}$ oz. each, are valued at $13.50. What will be the cost of a silver tankard weighing 1 lb. 10 oz.?

48. If a man can do a piece of work in 32 dys., by working 10 hrs. a day, how many days will it take him to do the same piece of work if he works 8 hrs. a day?

49. If $\frac{3}{8}$ of a yacht be worth $9600, what will $\frac{7}{8}$ of it cost?

50. If 8 cwt. of sugar cost $48, what will 74 cwt. be worth?

51. If the fare for 165 mi. be $4.29, what would it be for 630 mi.?

52. If 24 lbs. of rice cost $1.02, what will 112 lbs. cost?

53. If 4 men do $\frac{1}{2}$ of a piece of work in 15 dys., how many men will be required to finish it in 12 dys.?

54. If a man spend $4453 in a year, how much will he spend in 117 dys.?

55. If 11 lbs. of rags will make 8 lbs. of paper, how many pounds of rags are required to make 585 lbs. of paper?

56. If 36 lbs. of flour will make 45 loaves of bread weighing 1 lb. each, how many such loaves can be made from 56 bags of flour weighing $19\frac{1}{2}$ lbs. each?

57. A London merchant owes £3057 12 *s.*; the net value of his assets are £2675 8 *s.* What will a creditor receive to whom he owes £100?

58. If 12 rolls of paper 2 ft. wide will paper the walls of a certain room, how many rolls $\frac{7}{8}$ of a yard wide would be required?

59. How many yards of lining $\frac{7}{8}$ of a yard wide are required to line 16 yds. of cloth $\frac{3}{4}$ of a yard wide?

60. A bookseller receives 91 volumes of a certain work. The price of the book is \$3.20, but for every dozen taken one is allowed free of cost. What did the books cost him?

61. A man sold a house lot so that he received for it \$412.68. He thereby gained just 14%. What did the lot cost him?

62. If a man can do a piece of work in $9\frac{3}{8}$ dys. of $8\frac{4}{5}$ hrs. each, how many hours per day must he work in order to do the same amount in $7\frac{5}{7}$ dys.?

63. If velvet $\frac{4}{7}$ of a yard wide cost \$9 per yard, what should be the price when it is $\frac{4}{5}$ of a yard wide?

64. If 39 yds. of silk $\frac{3}{4}$ of a yard wide will make a certain number of neckties, how many yards $\frac{5}{8}$ of a yard wide would make the same number?

65. If an express train passes over 55 mi. in 53 min., how far would it go at the same rate in 2 hrs. 39 min.?

66. One workman is paid $\frac{3}{4}$ of the wages of another. How much will the second earn while the first earns \$138?

67. If 7 men can do a piece of work in 13 dys., how long will it take 9 men to do the same work?

68. Divide 90 into two parts proportional to 4 and 6.

69. Divide 300 into two parts such that the first may be to the second as 2 to 5.

70. Divide 780 into parts proportional to the numbers 3, 5, and 7.

71. A bell-founder receives an order to cast a bell weighing 1000 lbs., and containing 77% copper, 21% tin, and the remainder zinc. How many pounds of each metal are required?

72. Two men hire a pasture for $50, and pay $3.55 for repairing the fence. One man puts 20 horses into the pasture for 12 wks., and the other 15 horses for 18 wks. What ought each man to pay?

73. A merchant goes into bankruptcy. His assets were $21,380, his liabilities $91,000, and expenses of settlement amounted to $3180. How much will his creditors receive on the dollar, and what sum will a creditor receive to whom the merchant owes $6200?

74. A man dies owing three creditors $8050, $2970, $7170, respectively. His assets, deducting all expenses, amount to $13,646. What will each creditor receive, and also what per cent of his just dues?

75. Divide 264 into three parts which shall be as the numbers $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$.

76. Divide 1270 into parts proportional to the numbers 3, $4\frac{1}{3}$, $5\frac{1}{5}$, $6\frac{2}{7}$.

77. Three heirs receive from an estate, one $4700, another $3200, and the third $12,500, on condition that they together pay a debt of $2000. What amount net will each heir receive?

78. Four men engage in a business where the profit is $1200. How much of it should each man receive, if the first man put in $3000, the second $5000, the third $4200, and the fourth $2400?

79. A merchant goes into bankruptcy with liabilities $40,000, and assets $24,000. What can he pay on a dollar, the expenses of settlement amounting to $1800?

80. A wine merchant put into an empty cask 15 qts. of brandy costing him \$1.10 per quart, 66 qts. costing \$1.20 per quart, and 43 qts. costing \$1.40 per quart. What must be his selling price per quart in order to clear 20%?

81. A grocer mixes 120 lbs. of tea costing 50 cents per pound, with 180 lbs. costing 40 cents per pound. At what price per pound must he sell the mixture in order to make \$30 on the whole?

82. Flint glass is composed usually of 72% sand, 14% soda, 12% lime, and 2% alumina. How much of each of these substances is there in 10,000 lbs. of flint glass?

83. A master carpenter employs 7 men at \$3.10 per day, 6 at 2.80, and 5 at \$2.50. What is the average daily wage of the men?

84. If 10 men can reap a field of $7\frac{1}{2}$ A. in 16 dys. of 9 hrs. each, how many men are required to reap a field of $4\frac{1}{2}$ A. in 9 dys. of 12 hrs. each?

85. If 6 men can do a piece of work in 4 dys., how many more men must be employed to finish it 1 dy. sooner?

86. What length has the same ratio to 1 ft. $7\frac{1}{4}$ in. that $17\frac{3}{8}$ mi. has to 6 mi. 143 yds.?

87. If 5 men earn \$56.64 in 12 dys., how much will 18 men earn in 20 dys.?

88. A grocer buys two kinds of tea wholesale at 20 cents per pound, and 28 cents per pound, respectively, and mixes them in the ratio of 5 to 3. What is his profit if he sells 56 lbs. of the mixture at 42 cents a pound?

89. If 8 men can excavate 12,000 cu. yds. of earth in 36 dys. of $10\frac{1}{2}$ hrs. each, how many men will be required to excavate 8750 cu. yds. in 21 dys. of 7 hrs. each?

90. If a man travel 360 mi. in 12 dys. of 8 hrs. each, how many hours a day must he travel to accomplish 450 mi. in 20 dys. if he increase his rate 20 %?

91. If 102 knives are worth 153 forks, how many forks are worth 94 knives? How many knives are worth 1000 forks?

92. How many boys, each doing $\frac{2}{5}$ of a man's work, must be engaged with 14 men to do in 24 dys. what 12 men could do in 36 dys.?

93. A garrison of 5000 men provisioned for 179 dys. is, after 8 wks., diminished by 2000 men. How long will the food last the remainder of the garrison?

94. A cup weighs $9\frac{1}{5}$ oz., and is composed of gold and silver in the proportion of 15 to 1. What is the weight of each metal in the cup?

95. If 10 men can reap a field of $7\frac{1}{2}$ A. in 16 dys. of 12 hrs. each, how many hours a day must 8 men work to reap a field of $4\frac{1}{2}$ A. in 9 dys., if they can work 20 % faster than the former men?

96. A can do 30 % more work in a day than B. How long will B take to do a piece of work which A can do in 4 dys.?

97. If 15 men working 10 hrs. a day dig 450 yds. of a ditch in 18 dys., how many men will be required to dig 480 yds. in 8 dys., working 8 hrs. a day?

98. A grocer mixes 100 lbs. of tea which cost him 34 cents a pound with 27 lbs. of tea which cost him 60 cents a pound. He then sold the mixture at 49 cents a pound. How much did he make on the whole amount?

99. If 6 men can earn \$97.20 in 21 dys. of 12 hrs. each, how much can 4 men earn in 35 dys. of 10 hrs. each?

100. If 5 weavers can earn $152 in 18 dys., and 3 weavers can earn as much as 4 spinners, how much will 3 spinners earn in 24 dys.?

101. If 4 loads of hay will serve 6 horses for 8 wks., how many horses will 5 loads serve for 5 wks.?

102. If $27\frac{3}{5}$ mi. are travelled in $2\frac{5}{6}$ hrs., how long will it take to travel $11\frac{2}{3}\frac{1}{3}$ mi.?

103. If 32 meters equal 35 yds., how many meters are there in 56.35 yds.?

104. If 32 meters equal 35 yds., and a brass rod 1.5 meters long weighs 19 lbs. 11 oz., find the weight of an inch of this rod.

105. If 7 men in 8 dys. of 10 hrs. each earn $219, how many hours a day should 12 men work to earn $262.80 in the same number of days?

106. If a man can do $\frac{8}{11}$ of a piece of work in a day, how long would he take to do $\frac{5}{6}$ of a piece of work $5\frac{1}{4}$ times as much in amount, if he work $1\frac{2}{3}$ times as fast as before, but only $\frac{7}{8}$ as long each day?

107. Gun metal is composed of 11 parts of copper to 2 parts of tin. How much tin must be added to 209 lbs. of copper to make gun metal?

108. A garrison of 1500 men has just provisions enough to allow 26 oz. of bread a day to each man for 38 dys. If the garrison is increased by 400 men, how much bread must be assigned to each man, in order that the provisions may last for 65 dys.?

109. If 5 men and 8 boys can hoe 50 A. in 11 dys., working 10 hrs. a day, how long would it take 21 men and 15 boys to hoe 558 A., working 11 hrs. a day, supposing a boy does $\frac{2}{3}$ the work of a man?

110. Three towns, A, B, C, agree to drain an unhealthy swamp, and to raise for this purpose $23,000, each town to contribute according to its population. If the numbers of inhabitants are 4995, 6993, and 10,989, respectively, what sum of money must each town raise?

111. What can a bankrupt who owes $28,500, and whose assets are only $11,400, pay on a dollar?

112. Divide 1170 into three parts, such that the first shall be to the second as 2 to 3, and the second shall be to the third as 3 to 4.

113. A man dying left $7200 to be divided among three poor families according to the number of children in the families. The respective numbers being 6, 4, and 2, what sum will each family receive?

114. What per cent profit is made by buying a horse for $190 and selling him for $218.50?

115. If 4 men *or* 7 boys can do a piece of work in 6 dys., how long will it take 6 men *and* 9 boys to do it?

116. If it requires 5600 lbs. of manure of a certain kind to fertilize a field of 7 A. properly, how much manure 20% richer than the former will be needed for a field of $4\frac{1}{2}$ A.?

117. An alloy of $\frac{1}{2}$ copper, $\frac{3}{10}$ zinc, and $\frac{1}{5}$ nickel forms a substance strongly resembling silver. How much of each metal is there in 1000 lbs. of the alloy?

118. By walking 8 hrs. a day a man performed the journey from Albany to Niagara in 18 dys. What time would have been required had he walked 12 hrs. daily?

119. A shadow 5 ft. 8 in. long is cast by a pole 6 ft. high. What is the height of a spire that throws a shadow 156 ft. long at the same hour of the day?

120. A tank containing 6000 gals. leaks 1 gal. 2 qts. in one minute. In how long a time will it be emptied?

121. When $600 will earn $30 in 6 mos. 6 dys., how much will the same sum earn in 8 mos. 12 dys.?

122. A young man borrowed of a friend $7000 for 40 dys. For how long a time should the young man lend this friend $1750 to return the favor?

123. A piece of lining material $1\frac{1}{4}$ yds. wide will line 35 curtains. How many curtains will be lined by a piece of the same length $2\frac{1}{4}$ yds. wide?

124. When gold stood at 110, a clerk's salary paid in gold was worth $3570 in currency. What was the value of the salary in currency, with gold at 125?

125. A ship with a crew of 40 men had provisions for 3 mos. If the crew were reduced to 32 men, how long would these provisions last?

126. The floor of a drawing-room is covered by 40 yds. of carpet 1 yd. wide. How many yards of carpet $\frac{3}{4}$ of a yard wide would cover the same floor?

127. If $32\frac{2}{3}$ yds. of raw silk 20 in. wide will make a portière, how many yards of material 15 in. wide will be necessary?

128. If in working capacity 6 men are equal to 7 women, and 8 women to 11 boys; and if 5 men can do a piece of work in 10 hrs., how long will it take 1 man, 2 women, and 3 boys together to do the same piece of work?

129. A paper company consisting of three partners has to expend $530 in repairs. The partners have invested in the business, respectively, $2500, $3000, $4200. What sum must each partner pay?

130. If the rent of 3 A. for $\frac{1}{4}$ of a year be \$4, what will be the rent of 40 A. for 1 yr.?

131. The two large wheels of a tricycle are $6\frac{1}{4}$ ft. in circumference, and make 3000 revolutions in going a certain distance. How many revolutions will the small wheel, 5 ft. in circumference, make in going the same distance?

132. A certain quantity of coal will last 700 families 7 mos.; how long will it last 1600 families?

133. The interest on a certain sum at a given rate for 4 yrs. is \$53.40. What will be the interest for $8\frac{1}{5}$ yrs. on the same principal at the same rate?

134. For 6 yrs. at 4%, on \$964.75 the interest is \$231.54. What will be the interest at 6% on the given principal for the same time?

135. If \$6.03 interest is paid on \$67 for a certain time and rate, what principal will yield \$30.15 under the same conditions?

136. If a bushel of flour make 52 ten-cent loaves of bread, what should be the price per loaf when 60 loaves are made from a bushel?

137. If 8 cows eat 7 bu. of carrots in 9 dys., how many bushels will 17 cows eat in 12 dys.?

138. By travelling 8 hrs. per day for 10 dys., a man performs a journey of 200 mi. Were he to travel 12 hrs. per day, how many days would be required for a journey of 300 mi.?

139. If a baker can make 135 lbs. of bread with 180 lbs. of flour, how many pounds can he make with 920 lbs. of a kind of flour which will yield only $\frac{15}{16}$ as much bread as the first?

140. If it takes 238 lbs. of meal to last 7 horses 4 dys., how many pounds will support 27 horses 13 dys.?

141. A dry goods dealer paid $15,697.50 for 39 pieces of carpeting, each containing 175 yds. What should he pay for 78 pieces, each containing 180 yds., and the quality being better in the ratio of 15 to 14?

142. If 50 men working 9 hrs. a day require 6 dys. to dig a trench 100 yds. long, 2 yds. wide, and 3 yds. deep, how many men working 10 hrs. a day for 9 dys. will be required to dig a trench 50 yds. long, 6 yds. wide, and 5 yds. deep, at a place where the earth is twice as hard to handle?

143. Three men engage in trade for 4 yrs. The first put in $5200, but withdrew it after 4 mos. The second put in $7000, and withdrew it after 1 yr. 8 mos. The third put in $8600 for the whole time. The profit amounted to $68,833. How should it be divided?

144. Two capitalists contribute, one $10,000, the other $12,000, to an enterprise which continues in operation for 10 yrs.; 10 mos. after starting, a third man becomes a partner, and contributes $15,000, and 2 yrs. after this, a fourth man puts in $17,400. The total profit was $45,600. Find the share of each man.

145. An alloy of $\frac{8}{9}$ copper, $\frac{1}{26}$ zinc, and the rest tin forms an alloy strongly resembling gold. How much of each of the metals is there in 1000 lbs. of the alloy?

146. How many acres of wheat can be harvested in 3 dys. by 16 men, if 40 A. are harvested by 12 men in 9 dys.?

147. If a twelve-cent loaf weigh 40 oz. when flour is $8 per barrel, what will be the weight of a five-cent loaf when flour is worth $6 per barrel?

148. If $100 gain $2 in 3 mos., what sum will gain $4.40 in 11 mos.?

149. How much will $103 gain in 12 mos., if $600 gain $45 in 18 mos.?

150. If 15 sheep eat 37 bu. of potatoes in 27 dys., how many bushels will 74 sheep eat in 63 dys.?

151. A garrison of 1500 men has provisions for 12 wks., at the rate of 20 oz. per day to each man. How many men will the same provision support 20 wks., if 8 oz. per day are allowed to each man?

152. For 5 days' work, 8 men are paid $40. At the same rate, how much should 32 men receive for 24 days' work?

153. How many horses will be required to draw 132 t. of hay in 18 dys. to a railroad station, if 12 horses draw 44 t. in 5 dys.?

154. Find the wages of 9 workmen for 12 wks., if each man receive $1.80 per day.

155. If $2415 be a man's tax at the rate of $2\frac{1}{2}\%$ on $1, what is the rate on $1 when his tax is $3078.75?

156. On a certain railway line the telegraph posts are placed 58 yds. apart, and a passenger counts as he passes 37 in 2 min. At what rate per hour is he travelling?

157. A tailor engages to furnish suits for 330 children. The cloth cost $2640. The buttons, etc., for each suit cost $1.40. If he wishes to make a profit of $1.20 on each suit, how much must he charge for each suit?

158. Hay costs $22 per ton, and oats cost 60 cents per bushel. If one horse eat daily 25 lbs. of hay, and 10 qts. of oats, what will be the expense of keeping 5 horses from Dec. 1, 1883, to April 1, 1884?

159. A man spent $\frac{1}{5}$ of his money, then $\frac{8}{17}$, then $\frac{1}{4}$. He then had left \$10.65. How much had he at first?

160. If a canary bird eat 1 qt. of seed which costs 15 cents, in 3 mos., how much will it cost to keep 2 birds $1\frac{1}{2}$ yrs.?

161. I count 16 ticks of my watch between the instant of seeing a flash of lightning and that of hearing the report. At what distance is the thunder cloud, if sound travels 1056 ft. a second, and my watch ticks 128 times each minute, assuming that light passes from one place to another instantaneously?

162. I paid \$200 for 135 yds. of cloth. With the same sum, how many yards could I have obtained of a cloth 3 yds. of which are worth 5 yds. of the kind purchased?

163. Mary and Sarah can accomplish a given amount of sewing in $6\frac{2}{3}$ dys.; Mary and Lucy can perform the same work in $4\frac{4}{5}$ dys.; Mary, Sarah, and Lucy in $3\frac{3}{4}$ dys. How many days will Mary alone need for it?

164. If a man in pacing steps 3 ft. at a time, how many rods will he go in taking 184 steps?

165. If a teacher spend 30 min. each day on the classes in mental arithmetic, how many hours will be spent in a term of 12 wks. of 5 dys. each?

166. The mean distances of the great planets in miles from the sun are as follows:

Mercury,	35,393,000.	Jupiter,	475,693,000.
Venus,	66,131,000.	Saturn,	872,135,000.
Earth,	92,600,000.	Uranus,	1,753,851,000.
Mars,	139,312,000.	Neptune,	2,746,271,000.

If the distance of Mercury is represented by a line 1 ft. long, find to the nearest inch the lengths which will represent the other distances.

167. Railway companies almost always use for ties or sleepers young trees large enough to make only one tie for each cut. Trees of this size will not average more than two cuts each. Assuming 50 of these trees to the acre, the average distance apart of ties to be 2 ft., and the number of miles of track in the country to be 112,000, how many acres of woodland would be required to furnish all the ties?

168. The average duration of railroad ties has been found to be 7 yrs. Assuming the data in the last question, find how many ties are required each year for keeping the roads in repair, and also how many acres of woodland must be devoted to this purpose.

169. Assuming that it takes 30 yrs. for trees to grow to the size requisite for furnishing ties, how many acres of woodland are necessary to keep up the supply of ties for the existing roads? How many square miles of 640 A. each?

170. A vessel can be filled in 57 min. by one pipe which discharges 6 gals. a minute, and emptied in 38 min. by another. How many gallons a minute does the second pipe discharge? In how many minutes would the vessel be emptied if full, and both pipes were opened at the same instant?

171. A bookseller supplies the scholars of a town with pens, penholders, and paper. He charges 10 cents per quire for paper, 3 cents apiece for penholders, and 5 cents for 6 pens. He pays $1.60 per ream for the paper, 25 cents per dozen for the penholders, and 75 cents per box for the pens, each box containing 12 doz. pens. What is his profit for 1 yr., if he sells 80 reams of paper, 60 doz. penholders, and 30 boxes of pens?

172. If there are 360 scholars in the town referred to in the last example, how many pens and penholders, and how much paper, does each scholar on the average use during the year?

173. A salt-dealer put up 56,000 lbs. of salt in 20-lb., 10-lb., and 5-lb. boxes, using of each size the same number. How many boxes of each size were there?

174. Six men can reap a field 200 yds. long and 150 yds. wide, in 4 dys. of 12 hrs. each. In how many days of 10 hrs. each will 8 men reap a field 300 yds. long and 250 yds. wide?

175. If a piece of work can be finished by 5 men in 12 hrs., or by 4 boys in 20 hrs., how much time will be required to perform the same work by a man and a boy working together?

176. The interest on \$24 for 5 yrs. at 4% is \$4.80. What interest will accrue on \$360 in 4½ yrs. at 5%?

177. In 6 yrs. at 5% £825 interest will accrue on £2750. At what rate will £1160 interest accrue on £3625 in 8 yrs.?

178. In 3 yrs. at 4½% \$364.50 interest is paid on \$2700. In what time will \$8825 yield \$2294.50 at 4%?

179. \$2675 principal at 4% in 3 yrs. yields \$321 interest. What principal will yield \$93 at 5% in 7¾ yrs.?

180. With the understanding that a boy can perform only half the work of a man, how many hours per day must 42 boys work to accomplish as much in 45 dys. as 27 men would accomplish in 28 dys., working 10 hrs. per day?

181. A farmer can plant a field of corn in 8 dys. When his son works with him the work can be accomplished in 5 dys. In what time would the son alone perform the work?

182. A German laborer can harvest a crop of oats in 7 dys., an Irishman in 6 dys., and a Chinaman in 5 dys. If the German and the Irishman work together for 2 dys., and then the Chinaman join them, in how many days will the remaining portion of the work be completed?

183. Twenty horses working 14 wks., 6 dys. in the week and 8 hrs. a day, transport a certain quantity of coal from a mine to the nearest wharf. In how many weeks will 24 horses do the same work, if they be on the road 5 dys. in the week and 7 hrs. a day?

184. Divide 60 into two parts proportional to 11 and 9.

185. A lady divided $2500 between her four children so that their respective portions, beginning with the oldest, were as the numbers 2, 3, 7, and 8. What was the share of each?

186. Gunpowder is made of 75 parts of saltpetre, 10 of sulphur, and 15 of charcoal. How many pounds of each are contained in 1344 lbs. of gunpowder?

187. Twelve women or 18 girls can make $\frac{3}{4}$ of a dozen shirts in $6\frac{1}{2}$ hrs. How much time must be allowed for 11 women and 9 girls to finish the remainder of the dozen?

188. Three men engaged in a business in which the profit for one year amounted to $1275. What share of the profit is due to each man, if the respective amounts of capital which they furnished are as the numbers 3, 5, and 7?

189. If 3 mules are worth 5 sheep, what must be paid for 20 mules, when 4 sheep cost $17?

190. Three brothers having been together in business for one year, divide their gain, $837, in the proportion of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{6}$. What sum falls to the share of each?

191. Two neighbors in Florida carry on a fruit business, one furnishing $40 for 3 mos., and the other $75 for 4 mos. The profits are $70. Find the gain of each.

192. Express a speed of one mile per hour in terms of feet per second.

193. Three Frenchmen opened a restaurant in San Francisco, furnishing respectively $500 for 7 mos., $600 for 8 mos., and $900 for 9 mos. The profit is $410. What is the gain of each?

194. Five workmen working together finish a piece of work in 20 dys. and receive as pay $260.75. One of the men was absent 5 dys. and another 2 dys. The foreman is to receive 25 cents per day more than the others. What was the portion of each man?

195. If 120 men can make an embankment $\frac{3}{4}$ of a mile long, 30 yds. wide, and 7 yds. high, in 42 dys., how many men would it take to make an embankment 1000 yds. long, 36 yds. wide, and 22 ft. high, in 30 dys.?

196. Two men agree to do a piece of work for $63. They finish the work in 18 dys.; but one of them was absent 5 dys. of this time on account of sickness. How should the pay be divided?

197. Gilbert and Dan can hoe a piece of corn in 14 dys., Gilbert and Ernest can hoe it in 12 dys., Dan and Ernest in 15 dys. In what time can the work be done by the three working together?

198. Three herdsmen hired a pasture to be used in common, and paid $26.50. One put in 10 oxen for 3 mos.; another, 12 oxen for 4 mos.; and the third, 14 oxen for 2 mos. What rent should each pay?

199. The sum of the lengths of the three sides of a triangle is 480 yds., and these sides are as 3, 4, 5. What is the length of each side?

200. In time of war 1921 men are to be quartered upon 4 towns whose respective populations are 4150, 12,450, 24,900, 29,050. How many men according to the population should be assigned to each town?

201. 8% is lost by selling a roll of carpet for $38.64. What per cent would be gained by selling it for $57?

202. A manufacturer having in his employ 5 men, 7 women, and 14 boys, paid them all together in one month $52, in such proportion that each woman received $\frac{3}{7}$ of the sum paid each man, and each boy received $\frac{2}{3}$ of the sum paid each woman. Find the amount received for the month by the men, the women, and the boys.

203. Twenty-five lamps used 5 hrs. every evening for 20 dys. require a quantity of oil that costs $2.125. How many lamps used 4 hrs. every evening for 30 dys. can be furnished with oil at a cost of $7.65?

204. Five men and 7 boys can reap a field of rye containing 125 A. in 15 dys. In how many days will 10 men and 3 boys reap a field of 75 A. if the work of a boy be half that of a man?

205. The money that will pay the wages of Henry Wadsworth 61¼ dys. will pay the wages of Milton Rogers 81⅔ dys. For how many days will the same sum pay the wages of the two men?

206. A New York iron-merchant sold a quantity of car rails for $1391 at a gain of 7%. Had the rails been sold for $1235, what would have been the gain or loss per cent?

207. A tract of government land of 200 A. is to be divided among 4 soldiers according to the pensions received by each. If these pensions were respectively $500, $350, $800, and $90, what number of acres should each have?

208. Gerard Fiske and Hezekiah Wells together spend at a restaurant in 22½ dys. the same sum which would support Fiske alone 38⅘ dys. For how many days would this sum support Wells alone?

209. If a man can walk 4 United States miles in one hour, how much time will he need to walk a German mile, one United States mile being 0.2136 of a German mile?

210. A store and its stock of goods are worth $3190. The value of the goods is to that of the store as 9 to 2. What is the value of the goods?

211. When hay is worth $15 per ton in Boston, 8 horses can be kept 12 dys. for a certain sum. For how many days can 6 horses be kept at the same cost when hay is $12 per ton?

212. On a Fahrenheit thermometer the temperature of melting ice is marked 32°, and that of boiling water 212°. On a Centigrade thermometer the corresponding temperatures are marked 0° and 100°. If the mercury in a Centigrade thermometer stands at 35°, at what degree will it stand in a Fahrenheit thermometer?

213. The temperature of a room is 59° Fahrenheit. What is the corresponding reading on a Centigrade thermometer?

214. When water is 60° Fahrenheit, what temperature will be indicated by a Centigrade thermometer?

215. Seven women in 8 dys. of 11 hrs. each can make 22 doz. shirts. In how many days of 10 hrs. each can 12 women make 360 doz. shirts?

CHAPTER VII.

MENSURATION.

Note. *In this chapter the pupil is advised to draw neat and exact diagrams whenever the problem is one that admits of such illustration. Diagrams often make easy the solution of problems which without them would seem extremely difficult.*

Square each of the following numbers:

1. 7; 9; 28; 100; 1000.
2. 76; 329; 101; 100,408.
3. 0.6; 0.47; 0.009; 0.0504.
4. 9.02; 27.8; 18.09; 90.008.
5. 1500.81; 36.0018.
6. $\frac{1}{4}$; $\frac{1}{8}$; $\frac{2}{5}$; $\frac{5}{8}$; $\frac{12}{17}$.
7. $\frac{14}{15}$; $\frac{63}{82}$; $\frac{108}{211}$; $\frac{201}{2001}$.
8. $2\frac{1}{3}$; $9\frac{2}{7}$; $17\frac{3}{4}$; $149\frac{19}{21}$.
9. 19; 1006; 0.8; 0.002; 31.06; $\frac{75}{189}$; $16\frac{9}{11}$.
10. 87; 3003; 0.101; 182.4; 4.001; $\frac{91}{219}$; $201\frac{89}{200}$.

Extract the square root of the following numbers:

11. 1; 16; 49; 64; 81; 100; 400.
12. 144; 169; 625; 9025; 11,025.
13. 22,500; 32,400; 11,881; 4,004,001.
14. 0.04; 0.0025; 0.00013924; 0.40005625.
15. 6.25; 73.96; 16.4025; 256.672441.
16. $\frac{1}{16}$; $\frac{1}{9}$; $\frac{4}{25}$; $\frac{16}{49}$; $\frac{25}{36}$.
17. $\frac{169}{441}$; $\frac{625}{6400}$; $\frac{420025}{861201}$; $\frac{846681}{948864}$.
18. $86\frac{11}{49}$; $745\frac{129}{169}$; $1750\frac{366}{625}$; $3265\frac{277544}{494209}$.

Find the square roots of the following numbers, correct to *one* decimal place:

19. 536.	**21.** 59,785.	**23.** 5,193,583.
20. 4376.	**22.** 875,042.	**24.** 20,439,995.

Find the square roots of the following numbers, correct to *two* decimal places:

25. 53.2.	**27.** 100.052.	**29.** 95.767.
26. 49.24.	**28.** 9.254.	**30.** 6052.21.

Find the square roots of the following numbers, correct to *three* decimal places:

31. 4.532.	**33.** $8\frac{3}{7}$.	**35.** $4\frac{68}{115}$.
32. 3.55075.	**34.** $\frac{5}{9}$.	**36.** $15\frac{24}{25}$.

Find the square roots of the following numbers, correct to *four* decimal places:

37. 5.2.	**39.** 7.20051.	**41.** $9\frac{21}{23}$.
38. 4.005.	**40.** 3053.172.	**42.** $19\frac{47}{51}$.

43. What number multiplied by itself gives for the product 121,801?

44. The product of two equal numbers is 122,500. Find the numbers.

45. What is the number whose square root increased by 17 is equal to 71?

46. The sum of $676 was divided among a certain number of persons, so that each person received as many dollars as there were persons. How many persons were there?

47. Find the mean proportional between 35 and 1260.

48. A silver dollar is $1\frac{1}{2}$ in. in diameter. How many silver dollars could be laid flat side down on the surface of a table measuring 4 ft. on each side?

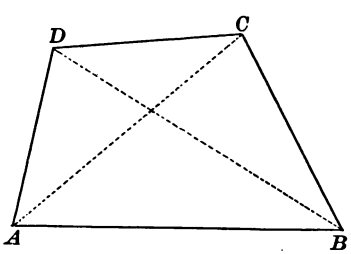
A **Plane** is a surface upon which straight lines can be drawn in all directions. The surface of still water is a good example of a plane surface.

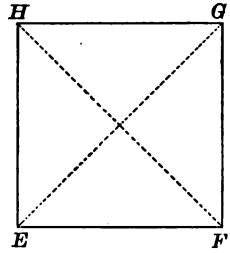
A **Plane Figure** is a portion of a plane surface bounded by lines.

The **Area** of a plane figure is the ratio of its magnitude to that of another plane figure assumed as the unit. For the units of area, see page 79. The unit most commonly used is the *square foot.*

A **Quadrilateral** is a plane figure bounded by four straight lines.

For example, *ABCD* is a quadrilateral; *AB*, *BC*, *CD*, *DA* are its *sides;* the points *A*, *B*, *C*, *D* are its *vertices;* the angles *ABC*, *BCD*, etc., are its *angles;* *AC* and *BD* are its *diagonals;* and $AB + BC + CD + DA$ is its *perimeter.*





A **Square** is a quadrilateral having all its sides equal and all its angles right angles. Thus, *EFGH* is a square.

The area of a square is found by multiplying the length of one side by itself; in other words,

Area of a square = square of one side.

Find the area, in square yards and smaller units, of a square, the length of whose side is:

49. 97 yds.	**52.** 372 ft.	**55.** 98 ft. 6 in.
50. 388 yds.	**53.** $19\frac{3}{4}$ ft.	**56.** 56 ft. 4 in.
51. $47\frac{4}{5}$ yds.	**54.** $87\frac{7}{8}$ in.	**57.** 69 ft. 2 in.

Find the area, in acres, square rods, and square yards, of a square, the length of whose side is:

58. 54 rds.	**61.** $29\frac{1}{2}$ rds.	**64.** 356 yds.
59. 43 rds.	**62.** $47\frac{1}{4}$ rds.	**65.** 267 yds.
60. $38\frac{3}{4}$ rds.	**63.** 89 yds.	**66.** 178 yds.

Find the length of one side of a square whose area is:

67. 285,156 sq. yds.

68. 1560.25 sq. yds.

69. $\frac{25}{36}$ sq. yd.

70. $\frac{361}{1444}$ sq. yd.

71. $2\frac{1}{4}$ sq. yds.

72. $4\frac{21}{25}$ sq. yds.

73. $97\frac{88}{64}$ sq. yds.

74. $286\frac{25}{144}$ sq. yds.

75. 43 sq. yds. $3\frac{1}{16}$ sq. ft.

76. 781 sq. yds. $6\frac{1}{64}$ sq. ft.

77. 20 A. 49 sq. rds.

78. 13 A. 129 sq. rds.

79. Find in yards the side of a square field which contains just 10 A.

80. What is the length of one side of a square field containing $15\frac{5}{9}$ A.?

81. A man owns a square lot containing 34 A. 36 sq. rds. What is the length of one side?

82. Find the perimeter of a square whose area is $2\frac{1}{2}$ A.

83. How many rods of fencing are required to enclose a square park containing 1000 A.?

84. Find one side of a square field containing $22\frac{1}{2}$ A.

85. A garden in the form of a square contains 4466 sq. ft. 100 sq. in. What is the length of one side?

86. A square plot of land 127 yds. long has a path 1 yd. wide running round on the *inside* of it. Find the cost of gravelling this path, at 15 cents per square yard.

87. What will it cost to build a stone wall around a square field containing 3 A. 44 sq. rds. 25 sq. yds., at $\$2\frac{5}{9}$ per yard?

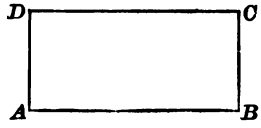
88. A square room is $15\frac{1}{2}$ ft. long. Find the length of a square piece of carpet that will just cover half the floor.

89. A walk $2\frac{1}{2}$ ft. wide round the *outside* of a square court 30 yds. long is to be paved. Find the cost, at 18 cents per square foot.

90. How many tiles 4 in. square are required to cover a square court, one side of which is 16 ft. 8 in. long?

91. The perimeter of a square is 684 yds. Find the area.

A Rectangle is a quadrilateral having all its angles right angles.



ABCD is a rectangle.

The opposite sides of a rectangle are equal; that is,

$AB = CD$, and $AD = BC$.

The lengths of two adjacent sides, as *AB* and *AD*, give the *dimensions* of the rectangle; *AB* is the *length* or *base*, *AD* the *breadth* or *altitude*.

Area of a rectangle = length × breadth.

Find the area of a rectangle, having given:

92. Length 37 in., breadth 27 in.

93. Length 4 yds., breadth 3 yds. 2 ft.

94. Length 10 ft. 7 in., breadth 9 ft. 5 in.

95. Length 7 ft. 6 in., breadth 6 ft. 7 in.

96. Length 17 ft. 10½ in., breadth 5½ in.

97. Length 4 yds. 2 ft. 6 in., breadth 2 yds. 1 ft. 4 in.

98. Length 210 yds., breadth 180 yds.

99. Length 20 rds. 5 yds., breadth 12 rds. 1 yd.

100. Length 5 ch. 20 lks., breadth 4 ch. 35 lks.

Find the breadth of a rectangle, having given:

101. Length 26 yds., area 572 sq. yds.

102. Length 19½ yds., area 331½ sq. yds.

103. Length 26 yds. 2 ft., area 622 sq. yds. 2 sq. ft.

104. Length 140 yds., area 3½ A.

105. Length 1¼ mi., area 5 A.

Find the length of a rectangle, having given:

106. Breadth 18 in., area 36 sq. yds.

107. Breadth 78¾ yds., area 6733⅛ sq. yds.

108. Breadth 190½ yds., area 32 A. 18 sq. rds. 23½ sq. yds.

109. Breadth 136 yds., area 7 A. 21 sq. rds. 28¾ sq. yds

110. A square floor measures 17 ft. along one side. How many bricks 9 in. by 4 in. will cover it?

111. How many slates 14 in. by 11 in. are required to cover a roof 35 ft. by 22 ft.?

112. A street $\frac{1}{4}$ of a mile long has on each side a sidewalk $7\frac{1}{2}$ ft. wide. What will it cost to pave the sidewalk with stones each measuring 2 ft. 9 in. by 1 ft. 8 in., and worth 75 cents each?

113. A wall 23 yds. long and 13 yds. high is to be built of stones measuring 16 in. by $11\frac{1}{2}$ in. outside face. Find the cost of the material at $37.50 per hundred.

114. A lawn measures 72 yds. by 49 yds. Turfs measure 18 in. by 14 in., and cost, labor included, 75 cents per dozen. What will it cost to turf the lawn?

115. A floor is 27 ft. 6 in. long and 8 yds. wide. Planks are 11 ft. by 9 in. How many planks are needed to cover the floor, and what will they cost at 20 cents per square foot?

116. What will it cost to pave a courtyard $18\frac{1}{2}$ yds. by $15\frac{1}{2}$ yds. with flagstones 31 in. by 18 in., and costing $75 per hundred?

117. A house has 24 windows; 11 of them measure $3\frac{1}{2}$ ft. by $6\frac{1}{2}$ ft. each, the rest $2\frac{3}{4}$ ft. by $4\frac{1}{2}$ ft. each. The former are filled with panes 13 in. by $10\frac{1}{2}$ in., and the latter with panes $13\frac{1}{2}$ by $8\frac{1}{4}$ in. How many panes of each size will be required?

118. A path 8 ft. wide surrounding a rectangular court 60 ft. long and 36 ft. wide is to be paved with tiles 9 in. long and 4 in. wide. How many will be required?

119. A street $\frac{1}{2}$ of a mile long covers $1\frac{1}{4}$ A. What is the breadth of the street?

120. How many yards of paper 27 in. wide are required to paper a room 18 ft. long, 12 ft. wide, and 11 ft. high?

121. A carpet 15 ft. 6 in. long and 10 ft. 8 in. wide is put in the middle of a floor 20½ ft. by 16 ft. How many yards of carpet 27 in. wide will be required to cover the remaining part of the floor?

122. Find the cost of carpeting a room 18 ft. 9 in. long and 17 ft. 6 in. wide with carpet 2 ft. wide, running lengthwise, and costing $1.90 per yard.

123. A room is 23½ ft. long and 17½ ft. wide. Find the cost of carpeting the room with carpet at 75 cents per square yard, and whitening the ceiling at 6 cents per square yard.

Find the cost of carpeting and papering the following rooms, the carpet running lengthwise in each case:

124. Room 39 ft. by 23 ft., and 17 ft. high; with 3 windows, each 9½ ft. by 8 ft.; 2 doors, each 10½ ft. by 6 ft.; and 2 fireplaces, each 6½ ft. by 4 ft. Carpet is 24 in. wide, and costs $1.50 per yard; paper is 24 in. wide, and costs 75 cents per roll of 10 yds.

125. Room 19 ft. by 17 ft., and 13 ft. high; with 2 windows, each 7 ft. by 4 ft.; 2 doors, each 9½ ft. by 4 ft.; and one fireplace 6½ ft. by 4 ft. Carpet is 22 in. wide, and costs $1.65 per yard; paper is 22 in. wide, and costs $1.65 per roll of 12 yds.

126. Room 29½ ft. by 21½ ft., and 16 ft. high; with 6 windows, each 5½ ft. by 6 ft.; 2 doors, each 7½ ft. by 9 ft.; and fireplace 7½ ft. by 6 ft. Carpet is 21 in. wide, and costs $1.26 per yard; paper is 21 in. wide, and costs 35 cents per roll of 10 yds.

127. Room 32½ ft. by 21½ ft., and 16 ft. high; with 5 windows, each 7½ ft. by 6 ft.; 3 doors, each 9½ ft. by 6 ft.; 2 fireplaces, each 7½ ft. by 6 ft. Carpet is 22 in. wide, and costs $2.08 per yard; paper is 28 in. wide, and costs 70 cents per roll of 10 yds.

128. A room is 16 ft. by 16 ft., and 13 ft. high. It has 3 windows, each $3\frac{1}{2}$ ft. by 7 ft.; 2 doors, each 4 ft. by $7\frac{1}{2}$ ft.; a fireplace 3 ft. by $6\frac{1}{2}$ ft.; and a base-board 18 in. high. What will it cost to whiten the walls and ceiling, at 5 cts. a sq. yd., and paint the floor and base-board, at 6 cts. a sq. yd.?

129. What must be the breadth of a rectangular piece of wood 3 ft. 9 in. long, that its area may be the same as that of a piece 2 ft. 6 in. square?

130. An orchard containing 2 A. is rectangular in form, and its length is 5 times its breadth. Find the dimensions.

131. A square and a rectangle have the same perimeter, 100 yds. The length of the rectangle is 4 times its breadth. Which contains the greater area, and by how much?

132. Two fields contain each 12 A. One is in the form of a square, the other is a rectangle whose length is equal to 3 times its breadth. At $4 per rod, what will be the difference in the cost of fencing the two fields?

133. A man wishes to cut from a square field a rectangular lot containing a quarter of an acre. If one side of the field be taken for one side of the lot, and measures $3\frac{1}{2}$ chains, find the length of the other side.

134. How many planks, each 10 ft. long and 8 in. wide, will cover a floor 14 ft. 3 in. long and 13 ft. 4 in. wide?

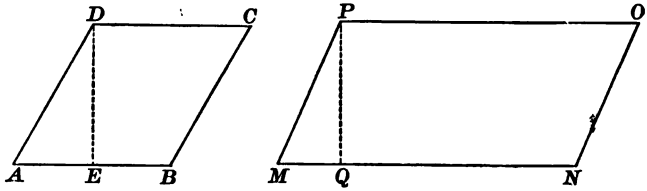
135. A man wants $3\frac{1}{2}$ sq. ft. of wood, and has only a plank 18 in. wide from which to cut it off. Find the length of the piece he must cut off.

136. What will it cost to line with lead, at 1 cent per square inch, the inside of an open cistern 10 ft. long, 6 ft. wide, and 4 ft. deep?

137. If it costs $448 to fence a square field, at $4.40 per rod, what would it cost to fence the same amount of land in the shape of a rectangle 196 yds. long?

A **Rhombus** is a quadrilateral having *all* its sides equal, but its angles not right angles.

ABCD is a rhombus; *AB* is called its *base*, and the line *DE*, drawn from *D* perpendicular to *AB*, is called its *altitude*.



A **Rhomboid** is a quadrilateral having its *opposite* sides equal, and its angles not right angles.

MNOP is a rhomboid; *MN* is its *base* or *length*; *PQ* drawn perpendicular to *MN* is its *altitude*.

A **Parallelogram** is a quadrilateral having its opposite sides parallel. The square, the rectangle, the rhombus, and the rhomboid are all of them parallelograms.

The opposite sides of a parallelogram are equal, and the opposite angles are also equal.

The sum of the four angles of any parallelogram is equal to four right angles, or 360°.

Area of any parallelogram = base × altitude.

Find the area of a parallelogram, having given:

138. Base 18 in., altitude 13 in.

139. Base 26 yds. 2 ft., altitude 23 yds. 1 ft.

140. Base 93 yds. 1 ft., altitude 106 yds. 2 ft.

141. Base 25 yds. 2 ft. 8 in., altitude 23 yds. 1 ft. 4 in.

142. Base 16 ft. 6 in., altitude equal to 4 times the base.

143. Base 1 furlong 10 rds., altitude 25 rds.

144. Base 6 ch. 25 lks., altitude 5 ch. 40 lks.

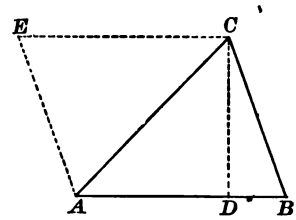
145. Base 12 ch. 50 lks., altitude 9 ch.

146. The area of a parallelogram is 4 A. 79 sq. rds., and the base is 7 ch. 19 lks. Find the altitude.

A **Triangle** is a plane figure bounded by three straight lines. The figure ABC is a triangle.

A triangle, ABC, has three sides, AB, BC, AC, and three angles, ABC, BCA, CAB.

The side AB is called the *base*, the opposite corner C the *vertex*, and the perpendicular CD, drawn from C to AB, the *altitude*. Either one of the other sides might be taken as the base. If AC is taken as the base, the opposite corner B would be the vertex, and the perpendicular drawn from B to AC would be the altitude.



The sum of the angles of a triangle is equal to two right angles, or 180°.

Any triangle, ABC, is equal in area to one-half of a parallelogram, $ABCE$, having the same base AB as that of the triangle, and also the same altitude CD: therefore,

$$\textit{Area of a triangle} = \tfrac{1}{2}(\textit{base} \times \textit{altitude}).$$

If the three sides of a triangle are given, the area is found as follows: From the half-sum of the sides subtract each side separately. Multiply the half-sum and the three remainders together. The square root of the product is the area of the triangle.

Find the area of a triangle, having given:

147. Base 17½ yds., altitude 4¾ yds.

148. Base 53 yds. 1 ft., altitude 46 yds. 2 ft.

149. Base 20 ft. 6 in., altitude 10 ft. 4 in.

150. Base 148 rds. 2 yds., altitude 69 rds. 1½ yds.

151. Base 10 ch. 35 lks., altitude 8 ch. 32 lks.

152. Sides 50 ft., 40 ft., and 30 ft.

153. Sides 104 ft., 111 ft., and 175 ft.

154. Sides 380 yds., 420 yds., and 765 yds.

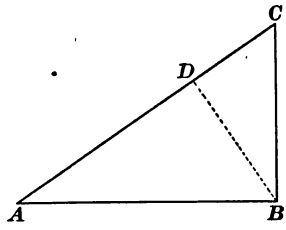
155. Sides 2 ch. 73 lks., 4 ch. 25 lks., 6 ch. 28 lks.

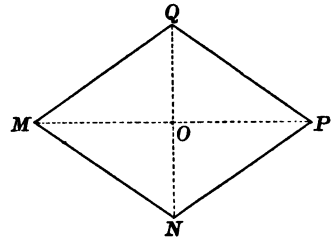
A **Right Triangle** is a triangle having a right angle.

In the right triangle ABC, the right angle is at B; the sides AB, BC, which form the right angle, are called the *legs*, and the side AC is called the *hypotenuse*.

The sum of the two acute angles of a right triangle is equal to one right angle, or 90°.

If one of the acute angles is equal to 30°, the opposite side is equal to half the hypotenuse.





The sum of the squares upon the two legs of a right triangle is equal to the square upon the hypotenuse; or,

$$\overline{AB}^2 + \overline{BC}^2 = \overline{AC}^2.$$

If one of the legs, as AB, be taken for the base, then the other leg BC will be the altitude; therefore,

Area of a right triangle = half the product of its legs.

The diagonals of a rhombus $MNPQ$ bisect each other at right angles, and divide the rhombus into four equal right triangles; hence

Area of a rhombus = half the product of its diagonals.

Find the hypotenuse and the area of a right triangle if:

156. The two legs are 3 ft. and 4 ft.

157. The two legs are 16 ft. and 12 ft.

158. The two legs are 108 ft. and 81 ft.

159. The two legs are 332 ft. and 249 ft.

160. The two legs are 23 rds. and 37½ rds.

161. The two legs are 30 rds. and 220 yds.

Find one leg of a right triangle, having given:

162. Hypotenuse 10 ft., one leg 8 ft.

163. Hypotenuse 50 ft., one leg 30 ft.

164. Hypotenuse 31 ft. 5 in., one leg 12 ft. 8 in.

165. Hypotenuse 945 yds. 1 ft., one leg 345 yds. 1 ft.

Find the area of a right triangle, having given:

166. Hypotenuse 25 in., one leg 15 in.

167. Hypotenuse 95 ft., one leg 76 ft.

168. Hypotenuse 207½ ft., one leg 124½ ft.

169. Hypotenuse 37½ rds., one leg 25 rds.

170. Hypotenuse 173¾ rds., one leg 104½ rds.

171. Hypotenuse 13 ch. 79 lks., one leg 9 ch. 85 lks.

172. The legs of a right triangle are each equal to 12 ft. Find the hypotenuse.

173. The side of a square is 100 ft. Find the diagonal.

174. The hypotenuse of a right triangle is 28 ft. long, and the two legs are equal to each other. Find their lengths.

175. The diagonal of a square is 33 ft. 4 in. What is the length of each side?

176. The diagonal of a square room is 37 ft. Find the cost of a carpet 1¼ yds. wide, at $1.80 per square yard.

177. The diagonal of a square field measures 340 yds. What will it cost to fence it at $2 per rod?

178. The diagonal of a rectangle is 46 ft. 5 in., and length is 44 ft. 4 in. Find its breadth.

179. A ladder 45 ft. long just reaches a window when placed with its foot 27 ft. from the side of the house. How high is the window above the ground?

180. The hypotenuse of a right triangle is 95 yds.; the two legs are as 3 to 4. Find the legs and the area.

Find the area and side of a rhombus, having given:

181. The diagonals 12 in. and 16 in.

182. The diagonals 26 yds. and 34⅔ yds.

183. The diagonals 11 ft. and 9 ft.

184. The diagonals 29 rds. and 21¾ rds.

185. The diagonals of a diamond-shaped pane of glass are 12 in. and 16 in. Find the number of square feet in 300 such panes.

186. The side of a rhombus is 31 yds. 2 ft.; one diagonal is 50 yds. 2 ft. Find the area and the other diagonal.

187. One side of a right triangle is 30 ft., and the opposite angle is 30°. Find the other two sides.

188. The acute angles of a rhombus are each equal to 60°, and the shorter diagonal is 16 ft. Find the area.

189. The acute angles of a rhombus are each equal to 60°, and the longer diagonal is 108 yds. Find the area.

190. Two vessels start at the same time from the same place, and sail, one due north, the other due east, at the rates of 6 and 8 mi. per hour respectively. How far apart will they be at the end of 6 hrs.?

191. What distance will a man save, if, instead of walking along the sides of a rectangular field 640 yds. long and 480 yds. wide, he crosses the field in a straight line from one corner to the opposite corner?

192. The breadth of the gable end of a house is 56 ft.; the distance of the ridge-pole from the ground is 75 ft.; the height of the eaves is 54 ft. Find the slant height of the roof.

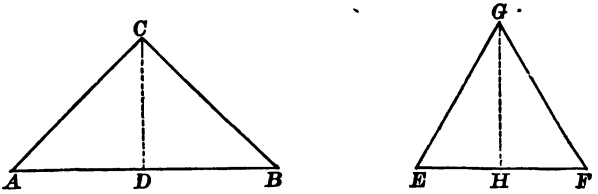
193. A room is 20 ft. long, 15 ft. wide, and 12 ft. high. Find the distance from one corner of the floor to the opposite corner of the ceiling.

An **Isosceles Triangle** is a triangle having two equal sides.

In the isosceles triangle ABC, AC and BC are the equal sides, AB is called the *base*, and C the *vertex*.

The angles opposite the equal sides are equal.

The altitude CD bisects the base, and also the angle at the vertex C.



An **Equilateral Triangle** is a triangle having its sides all equal. The triangle EFG is an equilateral triangle.

The angles of an equilateral triangle are also equal, and each angle is equal to 60°.

The altitude GH bisects the base EF, and also the angle at the vertex G.

Find the area of an isosceles triangle, having given:

194. Base 16 in., altitude 13 in.

195. Base 3 ft., each of the equal sides 5 ft.

196. Equal sides each 96¾ yds., altitude 58 yds.

197. Equal sides each 40 ft., angle at vertex 90°.

198. Base 40 ft., angle at vertex 90°.

199. Base 80 ft., angle at base 45°.

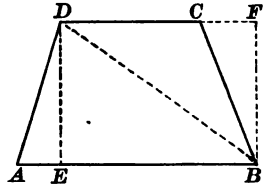
200. Base 150 ft., angle at base 30°.

201. The width of a house is 47 ft.; height to ridgepole 67½ ft.; height to eaves 39 ft. Find the cost of painting the side of this house at 2 cents per sq. ft., allowing 240 sq. ft. for windows.

202. The side of an equilateral triangle is 14 yds. Find the area.

203. How much larger is a square than an equilateral triangle having the same perimeter: namely, 60 ft.?

A **Trapezoid** is a quadrilateral having two of its sides parallel, but the other two sides not parallel.



The figure *ABCD* is a trapezoid.

The parallel sides *AB*, *CD* are called the *bases*. The distance *DE* or *BF* between the bases is called the *altitude*.

The diagonal *BD* divides the trapezoid into two triangles, having for their respective bases the bases of the trapezoid, and having equal altitudes (*DE* and *BF*); hence,

Area of trapezoid $= \frac{1}{2} \times$ *sum of bases* $\times$ *altitude.*

Find the area of a trapezoid, having given:

204. Bases 37 ft. and 25 ft., altitude 19 ft.

205. Bases 1 ft. 5 in. and 1 ft. 11 in., altitude 4 ft. 8 in.

206. Bases 19½ yds. and 26½ yds., altitude 62 yds.

207. Bases 256 yds. and 144 yds., altitude 85 yds.

208. Bases 26½ rds. and 33½ rds., altitude 79 rds.

209. Bases 12 ch. and 8 ch., altitude 10 ch. 40 lks.

210. Find the altitude of a trapezoid if the area is 2990 sq. yds., and the bases are 76 yds. and 54 yds.

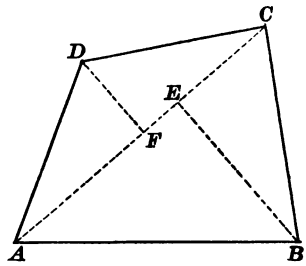
211. A field has the shape of a trapezoid. The parallel sides are 6 ch. 45 lks. and 3 ch. 55 lks. respectively, and the distance between them is 4 ch. 20 lks. Find the value of the field at $780 per acre.

212. A man paid $2262 for a field having the shape of a trapezoid. The parallel sides are 119 yds. and 200 yds., and the distance between them is 110 yds. What did the field cost him per acre?

213. Find the altitude of a trapezoid if the sum of its parallel sides is 231 rds., and its area is 115½ A.

A Trapezium is a quadrilateral having no two of its sides parallel to each other.

The usual method of finding the area of the trapezium is to measure the lengths of a diagonal, as AC, and also the lengths of perpendiculars to this diagonal dropped from the opposite corners B and D; then to compute the areas of the triangles ABC, ACD; and add the two results together.



Find the area of a trapezium $ABCD$, having given:

214. $AC =$ 35 yds., $BE =$ 19 yds., $DF =$ 17 yds.

215. $AC =$ 23 yds., $BE =$ 38 yds., $DF =$ 27 yds.

216. $AC =$ 47 yds., $BE =$ 56 yds., $DF =$ 49 yds.

217. $AC =$ 48 ft., $BE = 24\frac{1}{2}$ ft., $DF = 15\frac{1}{2}$ ft.

218. $AC = 34\frac{1}{2}$ ft., $BE = 19\frac{3}{4}$ ft., $DF = 14\frac{1}{4}$ ft.

219. $AC =$ 400 yds., $BE =$ 120 yds., $DF =$ 80 yds.

220. $AC =$ 79 rds., $BE =$ 67 rds., $DF =$ 53 rds.

221. Find the cost of a lot of land in the shape of a trapezium, at 25 cents per square foot, one diagonal being 108 ft., and the perpendiculars upon it from the opposite corners being 55 ft. 3 in. and 60 ft. 9 in.

222. Find the area of a trapezium $ABCD$ (see fig.), if $AB = 87$ ft., $BC = 119$ ft., $CD = 41$ ft., $DA = 169$ ft., and the diagonal $AC = 200$ ft.

223. Find the area of the trapezium $ABCD$, if $AD =$ 145 ft., $CB = 135$ ft., $AF = 87$ ft., $EC = 81$ ft., $AC = 368$ ft.

224. Find the area of a trapezium $ABCD$, if $AB = 48$ ch., $BC = 20$ ch., $AC = 52$ ch., $DF = 30$ ch.

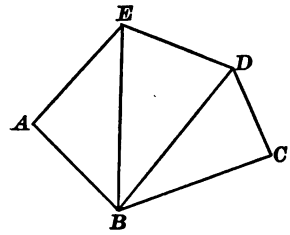
225. One diagonal of a quadrilateral is 10 ch., and the perpendiculars upon it from the opposite angles are 6 ch. 27 lks. and 8 ch. 6 lks. Find the area.

A **Polygon** is a plane figure bounded by straight lines. A polygon having *three* sides is called a *triangle;* having *four* sides, a *quadrilateral;* having *five* sides, a *pentagon;* having *six* sides, a *hexagon:* having *eight* sides, an *octagon;* having *ten* sides, a *decagon;* having *twelve* sides, a *dodecagon.*

The area of any polygon may be found by dividing it into triangles by means of diagonals, computing the areas of these triangles, and adding the results.

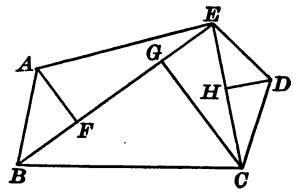
226. Find the area of the polygon *ABCDE*, having given:

AB, 61 yds., *AE*, 69 yds.,
BC, 140 yds., *BD*, 159 yds.,
CD, 23 yds., *BE*, 100 yds.
DE, 91 yds.,



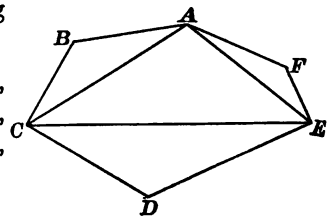
227. Find the area of the polygon *ABCDE*, having given:

BE, 108 yds., *EC*, 96 yds.,
AF, 49 yds., *DH*, 35 yds.
CG, 67 yds.,



228. Find the area of the polygon *ABCDEF*, having given:

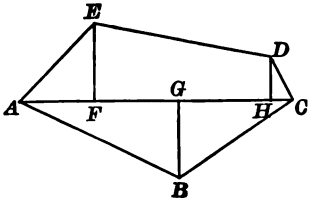
AB, 85 yds., *AF*, 105 yds.,
BC, 76 yds., *AC*, 105 yds.,
CD, 87 yds., *CE*, 143 yds.,
DE, 100 yds., *AE*, 116 yds.
EF, 17 yds.,



229. Find the area of the polygon *ABCDE*, having given:

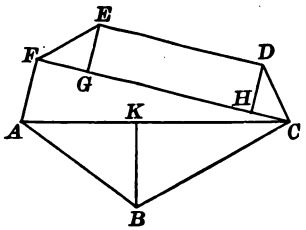
AC, 475 yds., *BG*, 160 yds.,
AF, 175 yds., *AH*, 420 yds.,
EF, 160 yds., *DH*, 90 yds.
AG, 320 yds.,

(Note that the figure *EF HD* is a trapezoid.)



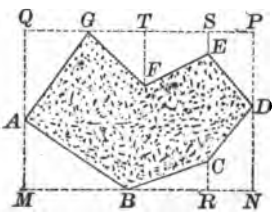
230. Find the area of the polygon *ABCDEF*, having given:

AC, 312 yds., *FG*, 63 yds.,
BK, 115 yds., *EG*, 54 yds.,
AF, 125 yds., *FH*, 283 yds.,
CF, 323 yds., *DH*, 60 yds.

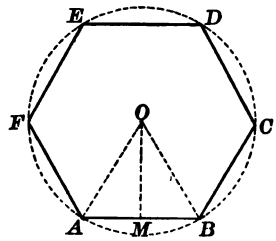


231. When it is difficult to enter a polygonal field for the purpose of measuring lines, the area may be found by surrounding the polygon by a rectangle, as shown below, and subtracting from the area of this rectangle the areas of the parts outside the polygon. Find the area of the swamp *ABCDEFG*, having given:

AM, 88 rds., *PS*, 45 rds.,
MB, 94 rds., *SE*, 20 rds.,
BR, 94 rds., *ST*, 65 rds.,
RC, 28 rds., *TF*, 48 rds.,
RN, 40 rds., *TG*, 58 rds.,
ND, 107 rds., *GQ*, 60 rds.,
DP, 104½ rds., *QA*, 123½ rds.



A **Regular Polygon** is a polygon having all its sides equal and all its angles also equal.



There is in every regular polygon a point equidistant from the corners and also equidistant from the sides; this point is called the *centre*.

The distance from the centre to any corner is called the *radius*, and the distance from the centre to any side is called the *apothem*.

The figure *ABCDEF* is a regular hexagon; *O* is the centre, *OA* the radius, *OM* the apothem.

The radii of a regular polygon divide the figure into equal isosceles triangles; hence it follows that,

Area of a regular polygon $= \frac{1}{2} \times$ *perimeter* $\times$ *apothem.*

The radius of a regular hexagon is equal to one side, and the radius of an equilateral triangle is equal to twice the apothem.

The apothem of a regular polygon bears a constant ratio (usually irrational) to one side; for most purposes the following values are sufficiently accurate:

No. of sides.	*Apothem.*	*No. of sides.*	*Apothem.*
3	one side $\times$ 0.2887.	7	one side $\times$ 1.0382.
4	one side $\times$ 0.5000.	8	one side $\times$ 1.2071.
5	one side $\times$ 0.6882.	10	one side $\times$ 1.5388.
6	one side $\times$ 0.8660.	12	one side $\times$ 1.8660.

Find the area of:

232. An equilateral triangle, if one side $= 2\frac{1}{2}$ ft.

233. A regular pentagon, if one side $= 3$ ft.

234. A regular hexagon, if one side $= 60$ ft.

235. A regular heptagon, if one side $= 30$ ft.

236. A regular octagon, if one side $= 30$ ft.

237. A regular decagon, if one side $= 38$ ft.

238. A regular dodecagon, if one side $= 10$ ft.

239. What angle is formed at the centre by two adjacent radii of an equilateral triangle? a square? a regular hexagon? a regular octagon? a regular decagon? a regular dodecagon?

240. Show that the apothem of a regular hexagon $= 0.866 \times$ the side.

241. The perimeter of a regular hexagon is $25\frac{1}{2}$ ft. Find the area.

242. A park has the shape of a regular hexagon. Each side is 500 ft. long. What is the assessed valuation of the park at 8 cents per square foot?

243. Each side of a lot in the shape of a regular decagon measures 80 lks. Find the area.

244. How much land will be covered by a tent, the base of which has the shape of a regular heptagon, and measures 20 ft. on each side?

245. Find the side of a square having an area equal to that of a regular hexagon whose side is 4 ft.

246. What area can be paved with 1000 tiles in the shape of regular octagons, the side of each octagon being equal to 3 in.?

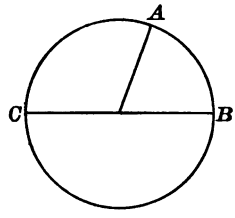
247. The radius of a regular decagon is 24 yds., the apothem is $22\frac{3}{4}$ yds. Find the area (to the nearest square yard).

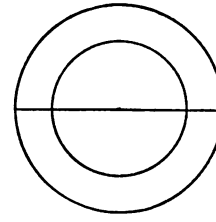
248. How many hexagonal paving-stones measuring 1 ft. on each side, are required to pave the floor of a hall 60 ft. long and 20 ft. wide, allowing 5% extra to fill corners?

249. A field has the shape of a regular hexagon, and one side is 247 yds. Find its value at \$242 per acre.

250. Find the cost of carpeting a regular octagonal floor, one side of which is 12 ft., with carpet 29 in. wide, and costing \$1.70 per square yard.

A **Circle** is a plane figure bounded by a curved line called a *circumference*, every point of which is equally distant from a point within called the *centre*. A line drawn from the centre to the circumference is called a *radius*, and a line drawn through the centre and limited by the circumference is called a *diameter;* therefore a diameter is equal in length to two radii.





The circumferences of two circles have the same ratio to each other as their radii, or as their diameters. Thus, if the radius of a circle be doubled, the circumference will also be doubled; or, if the diameter be trebled, the circumference will also be trebled; and so on. It follows that the ratio of the circumference of a circle to its diameter is the same for all circles. The exact value of this ratio cannot be expressed by numbers, but the value near enough for most practical purposes is $\frac{22}{7}$.

Concentric circles are circles having the same centre.

Circumference of a circle $= \frac{44}{7} \times$ *radius.*

Radius of a circle $= \frac{7}{44} \times$ *circumference.*

Area of a circle $= \frac{22}{7} \times (\textit{radius})^2$.

Radius of a circle $= \sqrt{\frac{7}{22} \times \textit{area}}$.

Find the circumference and area of a circle, having given:

251. Radius 21 ft.

252. Radius 7 ft.

253. Radius 40 ft. 10 in.

254. Radius 7.7 yds.

255. Radius 28 rds.

256. Radius 4 ch. 62 lks.

257. Diameter 77 yds.

258. Diameter 49 ft.

259. Diameter $19\frac{1}{4}$ rds.

260. Diameter $115\frac{1}{2}$ rds.

261. Diameter 32 yds. 2 ft.

262. Diameter 18 yds. 2 ft.

Find the radius and the area of a circle, having given:

263. Circumference 132 yds.

264. Circumference 198 yds.

265. Circumference 396 yds.

266. Circumference 15 ft. 7 in.

267. Circumference 91 yds. 2 ft.

Find the radius and circumference, having given:

268. Area 2464 sq. ft.

269. Area 6237 sq. yds.

270. Area 6 A.

271. Find the area of a circle if the diameter is $18\frac{2}{3}$ yds.

272. Find the diameter of a circle if the area is 616 sq. in.

273. Find the area of a circle if the circumference is 2 mi.

274. A carriage-wheel whose diameter is $3\frac{1}{2}$ ft. made 1200 revolutions in going a certain distance. Find the distance.

275. The circumferences of two concentric circles are 440 ft. and 330 ft. respectively. Find the width of the ring.

276. How deep is a well, if the wheel whose diameter is 2 ft. 4 in. makes 30 revolutions in raising the bucket?

277. Find the cost of building a wall around a circular garden containing 22,176 sq. ft. at $6.20 per yard.

278. The side of a square is 11 ft. Find the diameter of a circle equal in area to the area of the square.

279. The diameter of a circle is 7 ft. Find the side of a square having an area equal to that of the circle.

280. Find the area of a circular ring 4 ft. wide, if the radius of the outer circle is 32 ft.

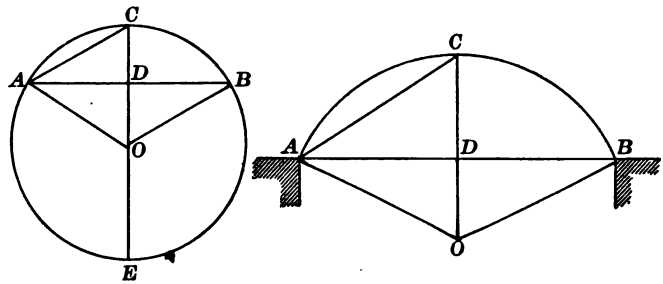
281. What will it cost to gravel a walk 6 ft. wide, running around a circular fish-pond whose diameter is 70 yds., at 20 cents per square yard?

An **Arc** is any part of a circumference, as ACB.

A **Chord** is a straight line joining the ends of an arc. Thus, AB is the chord of the arc ACB.

The diameter COE, drawn through the middle point D of the chord AB, bisects also the arc ACB, and is perpendicular to the chord; AD is half the chord AB, and AC is the chord of half the arc ACB; CD is called the *height* of the arc ACB. It may be proved that AC is a mean proportional between CD and CE, and that AD is a mean proportional between CD and DE; in other words,

$$\overline{AC}^2 = CD \times CE; \text{ and } \overline{AD}^2 = CD \times DE.$$



The arch of a bridge often has the form of a circular arc; in this case, AB is the *span*, CD the *height* or *rise* above the piers.

The angle AOB is the *angle at the centre* subtended by the arc ACB. Every circumference is regarded as composed of 360 equal arcs, called *degrees;* and an arc ACB contains the same number of degrees, minutes, and seconds as the angle at the centre AOB; also,

$$\frac{\textit{Length of an arc}}{\textit{Circumference}} = \frac{\textit{Number of degrees in arc}}{360°}.$$

282. Given $AC = 25$ ft., $CD = 15$ ft.; find CE.

283. Given $AC = 15$ ft., $OC = 20$ ft.; find CD.

284. Given $AD = 8$ ft., $AC = 10$ ft.; find OC.

285. Given $CD = 5$ in., $AD = 12$ in.; find CE.

286. Given $CD = 9$ in., $CE = 25$ in.; find AC.

287. Given $AB = 48$ ft., $CD = 18$ ft.; find OC.

288. Given $AC = 17$ ft., $CD = 7$ ft.; find EC.

289. Given $AC = 12$ ft., $CE = 36$ ft.; find CD.

290. The chord of half an arc is 28 ft., and the radius of the circle is 28 ft. Find the height of the arc.

291. The chord of an arc is 4 ft. 4 in., and the height of the arc is 1 ft. 1 in. Find the diameter of the circle.

292. The span of a bridge in the form of a circular arc is 78 ft., and the rise above the piers is 12 ft. Find the radius of the circle.

293. The height of the circular arch of a bridge is 24 ft., and the radius with which it is described is 312 ft. Find the span of the arch.

Find the length of an arc, having given:

294. Circumference 50 in., angle at centre 30°.

295. Radius 28 in., angle at centre 45°.

296. Diameter 35 in., angle at centre 36°.

297. Radius 84 ft., angle at centre 11° 15′.

298. The radius of a circle is 5 ft. 3 in. Find the whole perimeter of a sector the angle of which is 45°.

299. What angle at the centre is subtended by an arc 6 ft. 5 in. long, if the radius of the circle is 8 ft. 2 in.?

300. The radius of a circle is 7 in. Find the angle at the centre subtended by an arc whose length is also 7 in.

301. An arc of a circle is 5 ft. 6 in. The angle which it subtends at the centre is 72°. Find the radius.

302. If in a certain circle an arc of 120° is 88 ft. long, what is the length of an arc of 30° in a circle whose radius is 6 times that of the first circle?

303. A chord in a circle is 4 ft., and the corresponding angle at the centre is 90°. Find the length of the arc.

A **Sector** is a portion of a circle bounded by two radii and the arc contained between them. The figure $AOBC$ is a sector; the angle AOB is the angle of this sector.

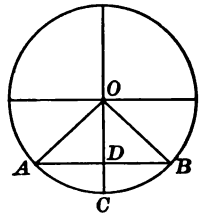
A **Segment** is a portion of a circle bounded by an arc and its chord. The figure $ADBC$ is a segment.

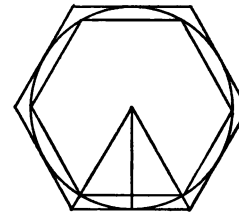
Every diameter divides a circle into two equal parts called *semi-circles;* and two diameters perpendicular to each other divide a circle into four equal parts called *quadrants.*

The area of a sector has the same ratio to the area of the entire circle that the arc of the sector has to the entire circumference; hence it follows that:

$$\frac{\text{Area of sector}}{\text{Area of circle}} = \frac{\text{Angle of sector}}{360°}.$$

The area of the segment $ADBC$ is found by subtracting that of the triangle AOB from that of the sector $AOBC$.





An *inscribed* polygon is a polygon whose sides are chords of the circle, and a *circumscribed* polygon is a polygon whose sides touch the circle. The radius of a circle is equal to the radius of every inscribed regular polygon, and to the apothem of every circumscribed regular polygon.

Find the area of a sector, having given:

304. Radius 14 in., angle at centre 45°.

305. Radius 2 ft. 11 in., angle at centre 24°.

306. Radius 56 ft., angle at centre $22\frac{1}{2}°$.

307. Radius 10 in., angle of sector 18°,

308. Radius 10 in., arc of sector = the radius.

309. The area of a sector is 882 sq. yds.; the radius of the circle is 42 yds. Find the length of the arc.

310. The angle of a sector is 60°, and the chord joining the ends of the arc is 14 ft. Find the area of the sector.

311. In a circle whose radius is 18 yds. 2 ft., find the area of a segment bounded by an arc of a quadrant and the corresponding chord.

312. The chord of a segment is 43 yds., and the angle subtended at the centre is 90°. Find the area of the segment.

313. The chord of a segment is 28 yds.; the angle at the centre is 60°. Find the area of the segment.

314. In a circle whose radius is 1 ft., what is the length of the arc subtended by one side of the inscribed regular decagon?

315. Find the area of a circle inscribed in a square whose area is 196 sq. ft.

316. Out of a square piece of wood 5 ft. 10 in. long is cut the largest possible circle. Find its area.

317. Out of a circular piece of wood whose radius is 3 ft. 4 in., is cut the largest possible square. Find its side.

318. The radius of a circle is 4 ft. Find the area of the inscribed regular hexagon.

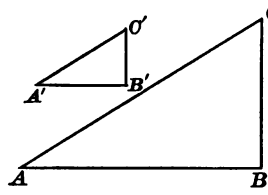
319. The radius of a circle is 4 ft. Find the area of the circumscribed regular hexagon.

320. The side of a square is 42 yds. Find the areas of the inscribed and the circumscribed circles.

321. The diagonal of a square is 54 yds. Find the area of the inscribed circle.

322. The radius of a circle is 9 yds. Find the areas of the inscribed and the circumscribed equilateral triangles.

Two polygons are **similar** if they are equiangular with respect to each other, and have their homologous sides proportional. The homologous sides are the sides opposite the equal angles. Thus, the triangles ABC, $A'B'C'$ are similar triangles, and



$$AB : A'B' = BC : B'C';$$
$$AB : A'B' = AC : A'C';$$
$$BC : B'C' = AC : A'C';$$

All regular polygons having the same number of sides are similar to each other.

The areas of two similar figures are proportional to the *squares* of any two homologous sides.

The radii of two regular polygons of the same number of sides are proportional to their sides; and the same is true of their apothems.

The areas of two regular polygons of the same number of sides are proportional to the *squares* of their sides, or the *squares* of their radii, or the *squares* of their apothems. The areas of two circles are as the *squares* of their radii, or as the *squares* of their diameters.

323. If a rod 3 ft. high casts a shadow 2 ft. long, how high is a tree which casts a shadow 60 ft. long?

324. If a triangular lot of land, one side of which is 80 ft., is worth $1000, what is a similar lot worth, the homologous side of which measures 240 ft.?

325. To what extent is the area of a polygon altered if its sides are all of them quadrupled?

326. The sides of two regular octagons are as 2 to 5. The area of the first is 80 sq. ft. Find the area of the other.

327. To what extent is the area of a regular polygon altered if its radius is reduced to one-fifth of its original value?

The radius of a circle is 3 ft. Find:

328. The radius of a circle 25 times as large.

329. The diameter of a circle 3 times as large.

Cube the following numbers:

330. 4; 7; 9; 37; 75.

331. 39; 130; 276; 100; 1000.

332. 109; 2007; 10,000; 29,045; 371,908.

333. 0.7; 0.29; 0.008; 0.7175; 0.10091.

334. 9.3; 24.8; 375.012; 80.0027.

335. 17.05; 2945.6; 13,005.91; 23.0014.

336. $\frac{1}{4}$; $\frac{1}{8}$; $\frac{2}{3}$; $\frac{2}{8}$; $\frac{5}{8}$; $\frac{14}{15}$; $\frac{28}{28}$; $\frac{66}{82}$.

337. $2\frac{1}{7}$; $9\frac{2}{3}$; $18\frac{3}{4}$; $168\frac{19}{28}$; $10{,}000\frac{34}{37}$.

Extract the cube root of the following numbers:

338. 1; 125; 343; 512; 729.

339. 1000; 2197; 3375; 27,270,901.

340. 35,937,000; 512,000,000; 1,003,003,001.

341. 0.001; 0.125; 0.064; 0.512.

342. 0.001728; 0.000000343; 0.000010529664.

343. $\frac{1}{343}$; $\frac{8}{729}$; $\frac{27}{64}$; $\frac{125}{216}$; $\frac{512}{729}$.

344. $\frac{2921811 2}{344472101}$; $\frac{654508 27}{1280240 64}$; $709\frac{11442}{15625}$; $1221\frac{21016}{91125}$.

Find the cube roots of the following numbers, correct to one decimal place.

345. 419. **347.** 8988. **349.** 1,765,789.

346. 2038. **348.** 307,504. **350.** 513,175,785.

Find the cube roots of the following numbers, correct to two decimal places.

351. 29.2. **353.** 97.005. **355.** $\frac{1}{7}$.

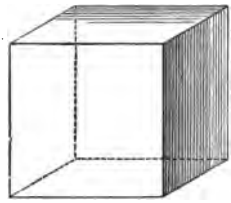
352. 410.23. **354.** 109.0126. **356.** $3\frac{2}{3}$.

Find the cube roots of the following numbers, correct to three decimal places.

357. 4.531. **359.** 0.63. **361.** $9\frac{88}{89}$.

358. 1.5046. **360.** $\frac{12}{18}$. **362.** $926\frac{188}{215}$.

A Solid is anything which has three dimensions, length, breadth, and thickness.



The boundary of a solid is called its *surface*. If the surface consist of planes, they are called the *faces*. The faces of a solid meet in lines called the *edges*.

A **Cube** is a solid bounded by six equal squares.

The three dimensions of a cube are equal.

The most convenient units of volume are cubes whose edges are units of length. The *cubic foot* and the *cubic inch* are examples of such units. (For other units, see page 80.)

Volume of a cube = cube of one edge.

Find the volume and also the entire surface of a cube, having given:

363. Side 3 in.

364. Side $8\frac{1}{2}$ in.

365. Side 8 ft. 6 in.

366. Side 2 yds. 1 ft. 3 in.

367. Side 1 ft. 2 in.

368. Side 2 ft. 3 in.

369. Side 20 ft.

370. Side 5 yds. 2 ft. 6 in.

Find the length of one edge of a cube, having given:

371. Volume 343 cu. in.

372. Volume 2 cu. ft. 1457 cu. in.

373. Volume 15 cu. ft. 1080 cu. in.

374. Volume 68 cu. ft. 145 cu. in.

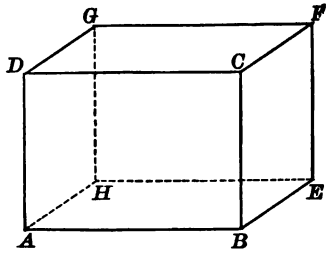
375. Find the weight of the water in a cubical cistern each side of which measures 6 ft. (See bottom of p. 80.)

376. How much lead is used in lining the bottom and sides of a cubical vessel that contains 729 cu. ft. of water?

377. A man wishes to construct a cubical vessel that will hold exactly 1 ton of water. What must be the length of one edge?

A Rectangular Parallelopiped is a solid bounded by six rectangular faces, each of which is equal and parallel to the face lying opposite.

The annexed figure represents a rectangular parallelopiped.



The face *ABCD* is equal and parallel to the face *EFGH*.

The lengths of the three edges which meet at any one of the corners are the *dimensions* of the solid; thus, *AB* is the length, *AH* the breadth, *AD* the thickness or height.

The face *ABEH* is also called the *base;* and then the edge *AD* is called the *height.*

The entire surface of a rectangular parallelopiped is the sum of the six rectangles of which it is composed, and the

$$\textit{Volume} = \textit{length} \times \textit{breadth} \times \textit{thickness}$$
$$= \textit{base} \times \textit{height}.$$

Find the surface and the volume of a rectangular parallelopiped, having given:

378. Length 10 in., breadth 8 in., thickness 6 in.

379. Length $9\frac{3}{4}$ ft., breadth $7\frac{1}{2}$ ft., thickness $6\frac{1}{4}$ ft.

380. Length $6\frac{3}{4}$ ft., breadth $5\frac{1}{2}$ ft., depth $4\frac{1}{4}$ ft.

381. Length $17\frac{3}{4}$ yds., breadth $13\frac{1}{6}$ yds., depth $11\frac{2}{3}$ yds.

382. Length $4\frac{1}{2}$ ft., breadth $1\frac{1}{2}$ yds., depth 54 in.

383. Length 4 ft. 8 in., breadth 3 ft. 10 in., height 3 ft.

Find the volume, having given:

384. Base 97 sq. in., height 10 in.

385. Base 3 sq. ft. 20 sq. in., height 1 ft. 3 in.

386. Base 11 sq. ft. 40 sq. in., height 5 ft. 3 in.

Find the height of a rectangular parallelopiped, given:

387. Volume 378 cu. in., length 9 in., breadth 7 in.

388. Volume $236{,}512\frac{1}{2}$ cu. yds., base $1114\frac{2}{3}$ sq. yds.

389. A cellar which measures 12 ft. by 9 ft. is flooded to a depth of 4 in. Find the weight of the water, supposing that 1 cu. ft. of water weighs 1000 oz.

390. What weight of water will a rectangular cistern hold, its length being 4 ft., breadth 2 ft. 6 in., depth 3 ft. 3 in., and 1 cu. ft. of water weighing 1000 oz.?

391. How much lead is required to line an open cistern 4 ft. 6 in. long, 2 ft. 8 in. wide, and containing 42 cu. ft.?

392. How many bricks 9 in. by $4\frac{1}{2}$ in. by 3 in. are required to build a wall 90 ft. long, 18 in. thick, and 8 ft. high?

393. A book is 8 in. long, 6 in. wide, and $1\frac{1}{4}$ in. thick. Find the depth of a box 3 ft. 4 in. long, and 2 ft. 6 in. wide, that it may hold 400 such books.

394. Find the expense of covering a flat roof 17 ft. 4 in. long and 13 ft. 4 in. wide with sheet lead $\frac{1}{16}$ in. thick, if a cubic inch of lead weighs $6\frac{1}{2}$ oz., and 1 lb. of lead costs 14 cents.

395. Marble is 2.716 times as heavy as water, and 1 cu. ft. of water weighs 1000 oz. Find the weight of a block of marble 9 ft. 6 in. long, 2 ft. 3 in. wide, and 2 ft. thick.

396. Iron weighs 7.2 times as much as water, and 1 cu. ft. of water weighs 1000 oz. What will an open cistern made of iron 1 in. thick weigh when empty, if its external dimensions are 5 ft., 4 ft., and 3 ft.?

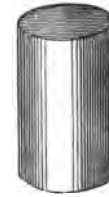
397. A cistern is 5 ft. 6 in. long, 3 ft. 9 in. wide, and 1 ft. 3 in. deep. How many gallons of water will it hold? What weight of water will it hold? (1 gal. of water = 231 cu. in., 1 cu. ft. of water weighs 1000 oz.)

398. Rain has fallen to the depth of half an inch. How many cubic feet of water have fallen on an acre of land?

A **Prism** is a solid bounded by two equal and parallel polygons called the *bases*, and by parallelograms called the *lateral faces*. The intersections of the lateral faces with one another are called the *lateral edges*.

A prism is called *triangular*, *quadrangular*, *hexagonal*, etc., according as the bases are triangles, quadrilaterals, hexagons, etc.

A **Right Prism** is a prism all of whose lateral faces are rectangles. The lateral faces and edges of a right prism are perpendicular to the bases.



A **Cylinder** is a solid bounded by two equal and parallel circles called the *bases*, and a curved surface called the *lateral surface*.

The line joining the centres of the bases is called the *axis*.

A **Right Cylinder** is a cylinder whose axis is perpendicular to the bases.

The *height* of a prism or a cylinder is the distance between its bases.

The height of a right cylinder is equal to the length of its axis.

The lateral surface of a right prism or a right cylinder is found by multiplying the *perimeter* of the base by the height.

Volume of a prism or cylinder = base × height.

(All the prisms and cylinders mentioned in the following examples are supposed to be right prisms and right cylinders.)

Find the volumes of the following prisms:

399. Base 23.5 sq. in., height 5.4 in.

400. Square base, side of base 13 in., height 19 in.

401. Triangular base, sides 10, 17, and 21 ft., height 16 ft.

402. Base an equilateral triangle, side 5 ft., height 23 ft.

403. Base a regular hexagon, side 4 ft. 9 in., height 25 ft.

404. Base a regular hexagon, side 10 in., height 10 ft.

405. Base a regular octagon, side 6 in., height 4 ft. 8 in.

406. Base a rectangle $3\frac{1}{2}$ ft. by $2\frac{1}{4}$ ft., height $15\frac{3}{4}$ ft.

Find the volume and also the lateral surface of the following cylinders:

407. Radius of base 7 in., height 10 in.

408. Radius of base 1 ft. 2 in., height 5 ft.

409. Diameter of base 8 ft. 2 in., height 4 ft. 6 in.

410. Diameter of base 9 ft. 4 in., height 12 ft.

411. Circumference of base 7 ft. 4 in., height 10 ft.

412. Find the radius of the base of a cylinder if the volume is 1540 cu. in., and the height is 10 in.

413. Find the height of a cylinder if the volume is 114 cu. yds. 2 cu. ft., and the radius of base 7 ft.

414. How many cubic yards of earth must be dug out to make a well 3 ft. in diameter, and 20 ft. deep?

415. The diameter of a well is 4 ft. 8 in., its depth is 30 ft. Find the cost for digging it at \$3.75 per cubic yard.

416. How many cubic yards of earth must be dug out in making a tunnel 100 yds. long, whose section is a semicircle with a radius of 10 ft.?

417. The bill for digging a well 45 ft. deep, and 3 ft. 9 in. in diameter was \$82.50. Find the charge per cubic yard.

418. If a cubic foot of brass is drawn into a wire $\frac{1}{11}$ of an inch in diameter, what will be the length of the wire?

419. What will it cost to sink a well 50 ft. deep and $3\frac{3}{4}$ ft. in diameter, at \$3.48 per cubic yard?

420. A cylindrical well is 119 ft. deep, and measures 4 ft. across the top. How many cubic feet of earth had to be dug out?

421. Is a cube a right prism? Why? Is a rectangular parallelopiped a right prism? Why?

422. What change in the volume of a cylinder is produced by doubling its height? By doubling the diameter of its base? By doubling both?

423. Two cylinders have the same height, but the radius of the base of one cylinder is 6 times that of the other. Compare their volumes. Compare also their lateral surfaces.

424. Find the cost of cementing the side and bottom of a cylindrical tank 20 ft. deep, and 18 ft. in diameter, at 32 cents per square foot.

425. How many gallons of water are there in a cylindrical well 7 ft. in diameter, if the water is 10 ft. deep?

426. How many inches will the water sink in a well 7 ft. in diameter, if 310 gals. of water are pumped out?

427. How many cylindrical pieces of lead $\frac{3}{4}$ of an inch in diameter and $\frac{1}{8}$ of an inch thick must be melted, in order to form a cube whose edge is 3 in. long?

428. What length of wire 0.08 of an inch thick can be formed out of a cubic inch of metal?

429. If a square iron rod 1 in. thick and 1 yd. long weighs $10\frac{1}{2}$ lbs., what would a round iron rod of the same length and thickness weigh?

430. How many revolutions must a roller 3 ft. long and $1\frac{1}{2}$ ft. in diameter make, in order to go completely over a grass plot half an acre in extent?

431. How large a cylinder can be made by rolling up a rectangular sheet of tin 80 in. by 60 in., so that the height of the cylinder is 80 in.? How large, if the height is 60 in.?

A Pyramid is a solid bounded by a polygon called the *base*, and by triangles called *lateral faces*, which all terminate in one point called the *vertex*.

A pyramid is *triangular*, *hexagonal*, etc., according as the base is a triangle, a hexagon, etc.

A Right Pyramid is a pyramid all of whose lateral faces are isosceles triangles. If the base of a right pyramid is a regular polygon, the vertex is in the perpendicular erected at the centre of the base.

A Cone is a solid bounded by a circle called the *base*, and by a curved surface called the *lateral surface*, which terminates in a point called the *vertex*.

A Right Cone is a cone whose vertex is in the perpendicular erected at the centre of the base. This perpendicular is called the *axis* of the right cone.

The *height* of a pyramid or cone is the distance from the vertex to the base. The *slant height* of a right cone is the distance from the vertex to the *circumference* of the base.

The lateral surface of a right cone is found by multiplying the circumference of the base by half the slant height.

Volume of a pyramid or cone $= \frac{1}{3}$ *base* $\times$ *height.*

(All the following questions refer to the right pyramid and right cone.)

Find the volumes of the following pyramids:

432. Area of base 64 sq. in., height 1 ft. 9 in.

433. Base an equilateral triangle, side 4 ft., height 15 ft.

434. Base a regular hexagon, side 6 ft., height 30 ft.

435. Base a regular octagon, side 24 ft., height 74$\frac{1}{4}$ yds.

Find the volume of a square pyramid, having given:

436. Side of base 3 ft. 4 in., height 9 ft.

437. Diagonal of base 78 yds.; height 30 yds.

438. Altitude of one face 18 in., height 13 in.

439. Lateral edge 29 in., height 17 in.

Find the whole surface of a square pyramid, having given:

440. Side of base 8 ft., altitude of each face 20 ft.

441. Side of base 26 ft., altitude of each face 84 ft.

Find the volume and also the curved surface of the following cones:

442. Radius of base 7 in., height 3 ft. 6 in.

443. Diameter of base 7 ft., height 10 ft.

444. Radius of base 3 ft. 6 in., slant height 5 ft. 10 in.

445. Radius of base 12 ft., slant height 37 ft.

446. Circumference of base 44 ft., slant height 25 ft.

447. Find the cost of covering a conical spire measuring 40 ft. round the base, and whose slant height is 30 ft., with lead $\frac{1}{8}$ of an inch thick, if 1 cu. in. of lead weighs $6\frac{1}{2}$ oz., and lead is worth 12 cents per pound.

448. How much canvas is needed to make a conical tent 8 ft. high, and 7 ft. in diameter at the base?

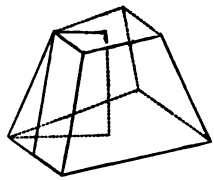
449. If 132 sq. ft. of canvas are formed into a conical tent whose slant height is 12 ft., find how much ground this tent will cover.

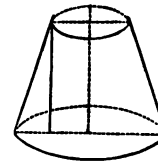
450. What length of canvas $\frac{3}{4}$ of a yard wide is required to make a conical tent 12 ft. in diameter and 8 ft. high?

451. A right triangle whose sides are 3 in., 4 in., and 5 in. in length, is made to describe a cone by turning round on the side 4 in. as an axis. Find the curved surface, and the volume of the cone thus generated.

A **Frustum** of a pyramid or cone is the part which remains after the top has been cut off by a plane parallel to the base. The base and the section made by the cutting plane are called the *bases* of the frustum.

The *height* of a frustum is the distance between the bases. The *slant height* of the frustum of a right cone is the distance from a point in the circumference of one base to the circumference of the other base.





The lateral surface of the frustum of a right pyramid is composed of trapezoids. The lateral surface of the frustum of a right cone is found by multiplying the sum of the circumferences of the bases by half the slant height.

To find the volume of a frustum, add together the areas of its bases and the square root of their product; then multiply the sum by one-third of the height.

Find the volumes of the following frustums:

452. Square pyramid, sides of bases 21 and 15 yds., height 84 yds.

453. Square pyramid, sides of bases 45 and 25 yds., height 96 yds.

454. Square pyramid, sides of bases 36 and 18 yds., height 120 yds.

455. Right cone, radii of bases 86 and 68 yds., height 57 yds.

456. Right cone, radii of bases 8 ft. and 6 ft., height 15 ft.

457. Right cone, radii of bases 5 ft. and 4 ft., height 6 ft.

458. How many square feet of tin will be required to make a funnel with the radii of top and bottom 14 in. and 7 in. respectively, and the height 24 in.?

459. A church spire has the shape of a frustum of a regular hexagonal pyramid; each side of the base is 5 ft., and of the top 2 ft; the altitude of each trapezoidal face is 20 ft. How many square feet of tin roofing are required to cover the lateral faces and the top?

460. Find the expense of polishing the curved surface of a marble column in the shape of a frustum of a right cone, slant height 12 ft., radii of bases 3 ft. 6 in. and 2 ft. 4 in., at 60 cents per square foot.

461. A round stick of timber is 20 ft. long, 3 ft. in diameter at one end, 2.6 ft. at the other. How many cubic feet does it contain?

462. A bucket is 16 in. deep, 18 in. wide at the top, and 12 in. wide at the bottom. How many gallons of water will it hold, reckoning $7\frac{1}{2}$ gals. to the cubic foot?

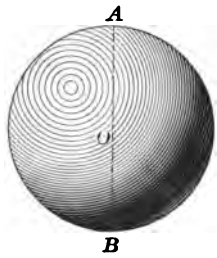
463. The mast of a ship is 51 ft. high, and the circumferences of its ends are 5 ft. 6 in. and 1 ft. 10 in. Find its value at 60 cents per cubic foot.

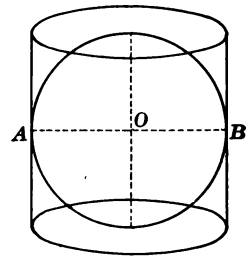
464. Find the volume of the frustum of a square pyramid, the sides of its bases being 40 ft. and 16 ft., and the altitude of a lateral face being 20 ft.

465. The chimney of a factory has the shape of the frustum of a square pyramid; its height is 180 ft., and the sides of its upper and lower bases are 10 ft. and 16 ft. respectively; the section of the flue is throughout the entire length a square whose side is 7 ft. How many cubic feet of brick does the chimney contain?

A **Sphere** is a solid bounded by a curved surface all points of which are equally distant from a point within called the *centre*.

A straight line drawn from the centre to the surface is called a *radius*, and a straight line drawn through the centre and terminated each way by the surface is called a *diameter*.





The *circumscribing* cylinder of a sphere is a cylinder whose height and the diameter of whose base are both equal to the diameter of the sphere (see Fig.).

It can be proved that the surface of a sphere is just equal to two-thirds the *total* surface of the circumscribing cylinder, and that the volume of a sphere is just equal to two-thirds the volume of the circumscribing cylinder. Hence it follows that (assuming π to be equal to $\frac{22}{7}$),

$$\textit{Surface of a sphere} = \tfrac{8}{7}\tfrac{8}{7} \times (\textit{radius})^2.$$

$$\textit{Volume of a sphere} = \tfrac{8}{21}\tfrac{8}{1} \times (\textit{radius})^3.$$

Find the surface of a sphere, if the radius is:

466. 5 in. **468.** 1 ft. 2 in. **470.** 10½ ft.

467. 10½ in. **469.** 3 ft. 6 in. **471.** 4060 mi.

Find the volume of a sphere, if the diameter is:

472. 14 in. **475.** 10 ft. 6 in. **478.** 42 ft.

473. 3 ft. 6 in. **476.** 17 ft. 6 in. **479.** 84 ft.

474. 5 ft. 10 in. **477.** 4 ft. 8 in. **480.** 126 yds.

481. The circumference of a dome in the shape of a hemisphere (half a sphere) is 66 ft. How many square feet of tin roofing are required to cover it?

482. If the ball on the top of St. Paul's Cathedral in London is 6 ft. in diameter, what would it cost to gild it at 7 cents per square inch?

483. How many gallons of water will a hemispherical vessel hold whose diameter is 21 in., reckoning 7½ gals. to the cubic foot?

484. If one cubic inch of iron weighs 4½ oz., what will be the weight of an iron ball 5 in. in diameter?

485. Find the weight of a spherical shell 10 in. in diameter and 2 in. thick, composed of a substance 1 cu. ft. of which weighs 216 lbs.

486. If an iron ball 4 in. in diameter weighs 9 lbs., what will an iron shell weigh whose external and internal diameters are 8 in. and 5 in. respectively?

487. If a cubic inch of lead weigh 7 oz., what will be the weight of a spherical shell made of lead ½ of an inch thick, and measuring 7 in. external diameter?

488. How many square feet of tin are required to make 16 hemispherical bowls, each to be 2 ft. 4 in. in diameter?

489. A shell is 7 in. in external diameter, and 2 in. thick. What weight of powder will fill it, if 30 cu. in. of powder weigh 1 lb.?

490. A circular room has perpendicular walls 15 ft. high; the diameter of the room is 28 ft.; the roof is a hemispherical dome. Find the cost of plastering the whole surface at 36 cents per square foot, and the cost of a moulding round the base of the dome, at 60 cents per foot.

Two cubes are to each other (in volume) as the *cubes* of their edges.

Two spheres are to each other as the *cubes* of their radii, or as the *cubes* of their diameters.

The surfaces of two spheres are as the *squares* of their radii, or as the *squares* of their diameters.

If the heights of two right cylinders, or two right cones, are proportional to the radii of their bases, the volumes of the cylinders, or of the cones, are as the *cubes* of the heights, or as the *cubes* of the radii of the bases; and the lateral surfaces are as the *squares* of the heights, or the *squares* of the radii of the bases.

491. The edges of two cubes are 6 in. and 7 in. What is the ratio of their volumes? If the volume of the smaller cube is 24 cu. ft., what is that of the larger?

492. The diameters of two spheres are 5 in. and 20 in. respectively. What is the ratio of their surfaces? What is the ratio of their volumes?

493. The radii of the earth, the moon, and the sun are as the numbers 1, $\frac{3}{11}$, and 112 respectively. If the volume of the earth be taken as unity, what would be the volumes of the moon and the sun?

494. A ball 9 in. in diameter is turned down in a lathe till the diameter is 8 in. What part of the whole volume is removed?

495. The diameter of an iron ball is 6 in. What is the diameter of an iron ball weighing $\frac{1}{27}$ as much?

496. If the height and radius of base of a cylinder are both trebled, to what extent is the volume altered?

497. The inside diameter of a hemispherical dome is 20 ft., and the uniform thickness is 2 ft. If it costs \$5 to paint the inside surface, what will it cost at the same rate to paint the outer surface?

MISCELLANEOUS.

498. What is the diagonal of a square whose area is 7 sq. in.?

499. A square field is 37 yds. long. What is the side of a square field 4 times as large?

500. A rectangular field 100 yds. wide contains $3\frac{1}{8}$ A. What is its length?

501. A rectangular cistern is 12 ft. 9 in. long, 8 ft. 3 in. broad, and $6\frac{1}{2}$ ft. deep. Find the expense of lining the sides and bottom with lead weighing 8 lbs. per square foot, and costing 6 cents per pound.

502. The dimensions of a rectangle are 45 yds. and 28 yds. Find its diagonal. Also find the diagonal of a square having the same area.

503. How many square yards of painting are there in a room 20 ft. long, $14\frac{1}{2}$ ft. wide, and $10\frac{1}{2}$ ft. high, with a fireplace 4 ft. by 4 ft. 4 in., and 2 windows each 6 ft. by 3 ft. 2 in.?

504. The length of each side of an equilateral triangle is 120 ft. Find the altitude.

505. Find the cost, at \$6.75 per yard, of building a wall around a garden in the shape of a right triangle whose hypotenuse is 97 yds., and one leg 72 yds.

506. The hypotenuse of a right triangle is 40 ft., and one angle is 45°. Find the other two sides.

507. A mast is partly broken by the wind at the height of 20 ft. from the deck, and the top touches the deck so as to form the angle 30°. Find the entire length of the mast.

508. One leg of a right triangle is 50 ft., and the opposite angle is 30°. Find the other leg.

509. A field has the shape of a parallelogram. Its base is 13 ch. 75 lks., its altitude is 6 ch. 25 lks. What is its value at $70 per acre?

510. Find the area of a rhombus whose diagonals are 66 yds. and 120 yds. respectively.

511. Find the cost, at $2 per square yard, to pave a courtyard in the form of a rhombus, if its diagonals are 45 yds. and 24 yds. respectively.

512. Find the area of a parallelogram whose adjacent sides are 64 ft. and 36 ft., and one of whose angles is 45°.

513. The diagonals of a rhombus are 90 yds. and 120 yds. respectively. Find each side and the altitude.

514. A triangular lot of land was sold for $8208. Its sides are 25 yds., 101 yds., and 114 yds. respectively. What was the price per square foot?

515. Compare the areas of a square and an equilateral triangle, if the perimeter of each figure is 60 ft.

516. The legs of a right triangle are 40 ft. and 30 ft. respectively. If a perpendicular be dropped from the vertex of the right angle to the hypotenuse, find the length of the parts into which the hypotenuse is divided, and the area of each part of the triangle.

517. A field has the shape of a right triangle, and the two legs are 100 yds. and 200 yds. respectively. How many acres does the field contain? And if a perpendicular be dropped from the vertex of the right angle to the hypotenuse, find the area of each of the parts into which the field is divided.

518. Find the value of a triangular field whose sides measure, respectively, 87 yds., 100 yds., and 143 yds., at 66 cents per square foot.

519. The diagonal of a trapezium is 54 ft., and the length of the perpendiculars to the diagonal from the opposite corners are 23 ft. 9 in. and 18 ft. 3 in. Find the area of the trapezium.

520. A field is bounded by four straight lines of which two are parallel. If the sum of the parallel sides is 1235 lks., and the distance between them is 240 lks., find the area of the field.

521. If a carriage-wheel make 220 revolutions in travelling half a mile, what is its diameter?

522. There are two concentric circles. The circumference of the inner circle is 16 ft. 6 in., and that of the outer circle is 18 ft. 4 in. Find the width of the ring.

523. The minute-hand of a clock is 5 in. long. How far does its point move in one hour?

524. Find the area of a semicircle if the radius of the circle is 14 ft.

525. The diameter of a circle is 56 ft. Find the side of a square equal to the circle in area.

526. The diameter of a circular grass-plot is 28 ft. What must be the diameter of a similar plot, in order that it may be just twice as large as the first?

527. Compare the areas of a circle, a square, and an equilateral triangle, if they all have the same perimeter; namely, 132 ft.

528. Find the cost of paving a circular court 30 ft. in diameter, at $1.35 per square foot, leaving in the centre a hexagonal space each side of which measures 2 ft.

529. The chord of half an arc is 17 ft. 9 in., and the height of the arc is 6 ft. 3 in. Find the diameter of the circle.

530. The chord of half an arc is 60 ft., and the diameter of the circle is 125 ft. Find the height of the arc.

531. How many cubic feet of stone are required to build a dam, 1000 ft. long, 20 ft. high, 10 ft. wide at the bottom, and 4 ft. wide at the top?

532. The distance around a reservoir in the shape of a regular hexagon is 360 ft. If the average daily loss from evaporation amounts to a layer of water 2 in. deep, how many cubic feet of water must be supplied daily to maintain the water at a constant level?

533. How many square feet of sheet iron are required to make a funnel 2 ft. in diameter and 40 ft. long?

534. I wish to have made a cylindrical pail 14 in. high, and holding exactly 4 cu. ft. What must be the radius of the base?

535. Iron weighs 7.2 times as much as water, and 1 cu. ft. of water weighs $62\frac{1}{2}$ lbs. Find the weight of a cylindrical iron shell 1 in. thick and 2 ft. long whose inner radius is 7 in.

536. Find the expense of polishing the curved surface of a marble column 7 ft. 4 in. in circumference, and 15 ft. high, at \$1.50 per square foot.

537. A cubic inch of gold weighs 11 oz. How many ounces of gold will be required in making a solid gold ornament in the shape of a right pyramid 6 in. high, with a square base each side of which is 3 in.?

538. A conical mound of earth measures 264 yds. around its base, and the slant height is 70 yds. Find how many cubic yards of earth it contains.

539. The volumes of two spheres are as 1 to 3. The diameter of the first is 7 in. Find the diameter of the other.

540. A bullet 3 in. in diameter is melted and then cast into a cylinder 2 in. in diameter. What is the height of this cylinder?

541. A plank is $23\frac{1}{2}$ in. wide. What length must be taken in order that the area of the part cut off may be 188 sq. ft.?

542. A room is 38 ft. by 29 ft. What will it cost to plaster the walls to the height of 19 ft., at $2\frac{1}{2}$ cents per square foot?

543. A street is $\frac{3}{4}$ of a mi. long, and 35 ft. wide. What will it cost to pave it with stones 11 in. by 3 in. upper surface, at $\$62\frac{1}{2}$ per 1000?

544. How many persons can have lots of $2\frac{1}{2}$ A. out of a field containing $2\frac{1}{2}$ sq. mi.?

545. A railway $22\frac{1}{2}$ mi. long is double-tracked with rails weighing 24 lbs. to the foot. Find the cost of the rails at \$50 per ton.

546. A lot containing $73\frac{3}{4}$ A. of land is for sale. A offers 20 cents per square foot, and B 9 cents per square link. Which offer is the best for the seller, and by how much?

547. A lawn 35 yds. by 27 yds. is to be covered with turfs 21 in. by 18 in. What will the turfs cost at 3 cents each?

548. Garden A is 40 yds. by 30 yds., and garden B is 96 yds. by 72 yds. If A is lengthened 10 yds. and B 12 yds., how much must the width of each be diminished in order that the areas may be unaltered?

549. The area of a floor is 588 sq. ft., and its length and breadth are as 4 to 3. Find them.

550. The sides of three squares are 4 ft., 5 ft., and 6 ft., respectively. Find the side of a square equal in area to their sum.

551. A concert-room measures 21 yds. by 16 yds., and $\frac{2}{3}$ of the floor is occupied by the orchestra. Benches 15 in. wide are placed for the audience across the room 2 ft. 3 in. apart, leaving a passage 4 ft. wide up the centre. Allowing 22 in. of bench to each person, how many can be seated?

552. A room is $31\frac{1}{2}$ ft. by 17 ft., and $12\frac{1}{2}$ ft. high, with 3 windows each $5\frac{1}{2}$ ft. by 6 ft., 2 doors each $7\frac{1}{2}$ ft. by 4 ft., and a fireplace 7 ft. by $6\frac{1}{2}$ ft. The carpet is 27 in. wide, costs \$2.50 per yard, and is laid lengthwise across the floor. The paper is 27 in. wide, and costs \$1.80 per roll of 10 yds. Find the cost of the carpet and the paper.

553. Two ships, making 6 mi. an hour each, sail from the same point. A starts at noon due west. At 3 P.M. B sails north. How far apart are they at midnight?

554. A tree is partially broken by the wind at the height of 38 ft. from the ground, and the top touches the ground at an angle of 45°. Find the height of the tree.

555. How many diamond-shaped panes of glass, measuring 6 in. and 5 in. diagonally, will fill a window 18 ft. by $12\frac{1}{2}$ ft.?

556. Find the value of a triangular lot whose sides are 40 yds., 40 yds., and 48 yds., at 27 cents per square foot.

557. A, B, and C are the corners of a right triangle right-angled at B, which is 176 yds. from C, and 189 yds. from A. In walking from A to C, how much is saved by going direct, instead of going round by B?

558. A barn is 49 ft. long. The roof is 32 ft. span, and rises 4 yds. perpendicular from the eaves, and makes a right angle at the ridge. Find the cost of slating it, at 15 cents a square foot.

559. If a box will hold 1200 balls 1 in. in diameter, how many balls 2 in. in diameter will it hold?

560. A meadow 120 yds. by 84 yds. is drained by tiles 18 in. long laid in rows 9 ft. apart. Find the cost at $7.20 per thousand.

561. Around a circular basin 17 ft. 6 in. wide is a walk 3 ft. 6 in. wide. What will it cost to gravel it at 30 cents per square yard?

562. A piece of land 100 yds. by 78 yds. is surrounded by a ditch which occupies 1880 sq. yds. What would be its dimensions if the ditch were filled up?

563. The gable end of a building is 41 ft. wide, 46½ ft. from floor to eave, and 15 ft. perpendicular from eave to ridge. Find the number of bricks 9 in. by 3 in. required for its facing.

564. What different areas will a cord 16 yds. long enclose, if arranged in the form of (i.) a square, (ii.) a circle, (iii.) an equilateral triangle, (iv.) an isosceles triangle with base 4 yds.?

565. A grass-plot has the shape of an equilateral triangle with side 12 yds. A circular basin is made in its centre touching each side. Find the area of the basin.

566. How many medals 2¼ in. in diameter can be struck out of a square sheet of metal one side of which is 15¾ ft. long? And how much metal will then be left?

567. What must be the length of a tether to enable a cow to graze over just 10 sq. rds.?

568. Allowing 7 ft. as a cow's length from horns to tail, how much more surface may she graze, if a rope 35 ft. long be tied to her tail instead of to her horns?

569. A table has the shape of a regular octagon, side 3 ft.; and another table has the shape of a regular hexagon, side 4 ft. What will it cost to paint both their surfaces, at 8 cents per square inch?

570. A single circular valve is required to replace three smaller ones containing severally 10, 20, and 30 sq. in. Find its diameter.

571. A boiler needs a safety-valve 10 in. in diameter, but has only an 8-in. one. Find the diameter of a second valve required to make up the deficiency.

572. A measuring wheel is $3\frac{1}{2}$ ft. diameter, and turns exactly 168 times in going round a circular pond. Find the area of the pond.

573. How must a circular lot of land 343 ft. in diameter be laid out so that a fish-pond in the centre, a flower-garden around the pond, and a walk around the garden, may each occupy $\frac{1}{3}$ of the entire area?

574. The piston of a pump is 16 in. in diameter, and moves through a space of 46 in. How many cubic feet of water will be thrown out by 1000 strokes?

575. A body is placed under water in a right cylinder 60 in. in diameter, and the level of the water is observed to rise 30 in. Find the volume of the body.

576. How much will a brass cylinder weigh under water if the height is 10 in., and the diameter of the base is 7 in.? Brass is 7.8 times heavier than water, and a body when immersed in water loses a weight equal to the weight of the water displaced.

CHAPTER VIII.

MISCELLANEOUS EXERCISES.

1. The chief items of expense in converting 450 bu. of Dakota wheat into bread ready for sale in Boston, according to Mr. Atkinson's book on "The Distribution of Products," are as follows: price paid the Dakota farmer for the wheat, 80 cents per bushel; railroad freights, $200; milling at Minneapolis into 100 bbls. of flour, $50; cost of barrels, $40; commissions and cartage, $30; total cost of converting 100 bbls. of flour into 30,000 lbs. of bread, $420. If each loaf of bread weighs $1\frac{1}{2}$ lbs. and is sold for 8 cents, what per cent profit can a Boston baker clear above all expenses by buying Dakota wheat and converting it into bread?

2. The change in the deposits in the savings banks of Massachusetts between 1865 and 1885 is shown by the following figures:

	1865.	1885.
Population,	1,267,330,	1,941,465.
Number of accounts,	291,488,	848,787.
Total amount deposited,	$59,936,482,	$274,998,412.

Find for each date the average deposit on each account, and also the average deposit per head of population.

3. A man has 50 qts. of wine which cost him 62 cents per quart. After adding 12 qts. of water, he wishes to sell it so as to make 25% on his outlay. What should be his selling price?

4. In round numbers the population of this country was 34,750,000 in 1865, and 57,000,000 in 1885. The total grain crop was 1,127,500,000 bu. in 1865, and 3,000,000,000 bu. in 1885. Which has increased more rapidly during the period between the dates mentioned, the population or the production of grain? If the number of bushels of grain per head in 1865 be represented by a line 1 in. long, how long a line would represent the number of bushels per head in 1885?

5. The wheat crop of the United States in 1884 was in round numbers 500,000,000 bu. Land of good quality in Texas will produce 20 bu. of wheat per acre. The area of Texas is 275,000 sq. mi. very nearly. How much good land would be required to raise the entire wheat crop of 1884, and what per cent of the area of Texas would suffice for this purpose?

6. The cotton factories of the world now require about 12,000,000 bales of cotton. Good land in Texas produces 1 bale to the acre, and Texas contains in round numbers 275,000 sq. mi. What per cent of the area of Texas would be sufficient for producing all the cotton required?

7. The wages of mechanics in Massachusetts are now (1886) about 25% higher than in 1860, and the prices of things are on an average about 20% lower. If a mechanic now receives $90 per month, how much money could he save in a year, supposing that he saved nothing in 1860, and that he has the same standard of living now as then, with no additional expenses?

8. When water is heated from the freezing-point to the boiling-point it expands $\frac{1}{24}$ in volume. If a cubic foot of water at the freezing-point weigh $62\frac{1}{2}$ lbs., what will a cubic foot of boiling water weigh?

9. A merchant imports to New York goods which cost him £616 sterling in London. He pays an ad valorem duty of 12% on the goods, and a commission of 7% to agents for selling them. The goods realize $7800. What is the merchant's net gain, the pound sterling being equal to $4.86?

10. A circular plate of lead 8 in. in diameter and 2 in. thick is converted without loss into spherical shot each 0.05 in. radius. How many shot does it make?

11. A tailor buys 38 yds. of cloth at $2.45 per yard. Sponging causes a shrinkage of 4%. What must be his selling price in order that he may gain 10%?

12. Two men perform a piece of work in 18 dys., and receive for it $189. One of the men was absent 5 dys. What amount of money should each man receive?

13. Six men undertake to do a piece of work in 15 dys. They work 10 hrs. a day, but at the end of 8 dys. they find that only half of the work is accomplished. How many hours a day must they work during the remaining time in order to finish the work in the time agreed upon?

14. A wine merchant imported 1315 gals. of wine at a cost of $3.33⅓ per gallon. After adding water in the ratio of a quart of water to each gallon of wine, he bottled the wine in bottles costing 5 cents each and holding a pint and a half. At what price per bottle must he sell the wine in order to make 50% profit on his money?

15. Five men have performed a piece of work in 20 dys., and have received for it $521.50. One of the men was absent 5 dys., and another was absent 2 dys. Another man receives 50 cents a day extra for directing the work. What should each man receive?

16. A milliner bought 275 bonnets at \$14.40 apiece. She sold $\frac{3}{5}$ of them at 15% advance, and the rest at \$13.75 each. What did she make by the transaction?

17. Hay costs \$22 per ton, and oats cost 80 cents per bushel. If 1 horse eat daily 20 lbs. of hay and 8 qts. of oats, what will it cost to feed 10 horses from Dec. 1, 1889, to Mar. 31, 1890, both dates included?

18. A boy sells paper at 20 cents a quire, and 6 pens for 5 cents. The paper costs him \$3.25 per ream of 20 quires, and the pens cost \$1.10 per box containing 18 doz. What is his profit in selling 80 reams of paper and 30 boxes of pens?

19. An ore contains 18% of pure lead, but 14% of this lead is lost in reducing the ore. What weight of ore must be treated in order to obtain 1 t. of pure lead?

20. A hall is lighted by 58 gas-jets every evening except Sunday from 5.45 P.M. to midnight; each jet burns 6 cu. ft. per hour. The price of the gas is \$1.25 per 1000 cu. ft. Find the cost of lighting the hall for the month of January, if the month begins on Friday.

21. From a pipe full of wine $\frac{2}{3}$ of the contents are drawn away, and then 35 gals. are added. The pipe is then just half full. How many gallons will it hold?

22. If a wheel revolves 91 times in $3\frac{3}{4}$ sec., how many times will it revolve in $5\frac{3}{4}$ hrs.?

23. If $\frac{3}{4}$ of a yard of velvet cost \$3, what will $\frac{4}{7}$ of a yard cost?

24. A locomotive travels $\frac{7}{12}$ of a certain distance in $3\frac{1}{2}$ hrs. In how many hours will it travel at the same rate $\frac{2}{5}$ of the same distance?

25. A schoolroom is 40 ft. long, $26\frac{1}{2}$ ft. wide, and $19\frac{1}{4}$ ft. high. If at least 80 cu. ft. of space and 8 sq. ft. of floor must be provided for each scholar, what is the maximum number of scholars which the room can provide for?

26. On a certain map the linear scale is one inch to five miles. How many acres are represented on this map by a quarter of a square inch?

27. If 1 lb. of dry oak wood gives out $\frac{2}{3}$ the heat furnished by 1 lb. of coal, and if a cord of the oak wood weighs 2700 lbs. and costs \$9, what should be the price of the coal per ton in order that it may be just as cheap as the wood?

28. A reservoir holding 6000 gals. is supplied by two pipes. One conveys 100 gals. in $1\frac{1}{2}$ hrs., the other 200 gals. in $4\frac{1}{2}$ hrs. If both pipes are turned on, in what time will they fill the reservoir?

29. An ore contains $\frac{4}{7}$ of its weight of iron, but 7% of this is lost in smelting. How many tons of ore must be handled annually in order that the daily output of iron may be $7\frac{2}{5}$ t., the number of working days in the year being 310?

30. Divide \$4832 among three persons in proportion to their ages, which are respectively 20 yrs., 24 yrs., and 26 yrs.

31. A man holds a note for \$1800 payable July 18. On May 7 he offers to cancel it for a note for \$500 payable May 25, another note for \$600 payable Sept. 4, and the remainder in cash. How much in cash should he receive when money is worth 6%?

32. Find the total proceeds of three notes, the first for \$1550 payable in 6 mos. 20 dys.; the second for \$1990 payable in 3 mos. 10 dys.; the third for \$2480 payable in 5 mos. 25 dys., all three notes being discounted at $4\frac{1}{2}$%.

33. A man invested in a business $216,800. The first year he lost 9% of his capital; the second year he lost $4\frac{3}{4}$% of what remained; but the third year he gained 44% of what was still left. How much capital did he have at the end of the third year? What rate per cent simple interest did his money yield for the whole period?

34. The base of the great pyramid near Cairo is a square 764 ft. on a side, and its height is 486 ft. What is the altitude of one of the triangular faces?

35. Find the length of the side of a cubical vessel that shall contain twice as much as one whose side is 8 in.

36. If a wall 42 ft. long, 10 ft. high, and $2\frac{1}{2}$ ft. thick contains 12,800 bricks, how many bricks of the same kind will be required for a wall 112 ft. long, 6 ft. high, and 2 ft. thick?

37. A ship valued at $51,200 belongs to A, B, and C. A owns $\frac{5}{16}$ of it, and B owns $\frac{1}{4}$ of the remainder. What should C pay them for their joint shares to make a profit of 20% by the purchase?

38. Copper is bought at $306 per ton, payable in 6 mos. At what price should it be sold the same day, giving 8 mos. credit, in order to gain 25%, money being worth 4%?

39. Two towns, A and B, are 30 mi. apart. The road between them goes over a hill the summit of which is 6 mi. from A. Two men set out at the same time from A and B; the former walks 4 mi. per hour up hill and $5\frac{1}{4}$ mi. per hour down hill, the latter $3\frac{1}{2}$ mi. up and $4\frac{1}{2}$ mi. down. How far from A will they meet?

40. Water expands 10% in freezing, and a floating body displaces an amount of water equal in weight to the body. What per cent of an iceberg is above water?

41. Four postmen deliver the letters in a certain city, two working 14 streets, and the other two 17 streets. The work of each of the latter streets is 20% less than that of each of the former streets. If a fifth man is brought in to help them in such a way that all five shall have equal work, in what ratio should he assist the two pairs of men?

42. Find the amount at compound interest of $735 in 18 mos. at 6% per annum, interest payable semi-annually.

43. A man sold a horse at a loss of 20%. If he had received $60 more, he would have gained 10%. What did the horse cost him?

44. Find the compound interest on $216 for 9 mos. at 5%, interest to be paid quarterly.

45. A, B, and C respectively invested $25,652, $20,988, and $16,324 in a business which yielded in one year a net profit of $5849.21. What was the share of each?

46. A hatter bought 363 straw hats for $484. He sold $\frac{2}{3}$ of them at a gain of $12\frac{1}{2}\%$, and the remainder at a loss of $6\frac{1}{4}\%$. What was his gain or loss per cent on the whole?

47. Find the amount of $5553\frac{1}{3}$ in $6\frac{2}{3}$ yrs. at $2\frac{1}{2}\%$, simple interest.

48. If a ship be lost which is insured for $88\frac{1}{3}\%$ of its value, and its value be $83,650, what would a man lose who owns $\frac{2}{5}$ of the ship?

49. If 3% bonds are at $89\frac{3}{8}$, what must be the price of 5 per cents that there may be no loss of income in selling out the former and buying the latter, allowing for a brokerage of $\frac{1}{8}\%$ in each transaction?

50. The average length of 10 sticks is 2 ft. $10\frac{1}{2}$ in.; one is $27\frac{1}{2}$ in. long, another $37\frac{1}{2}$ in. long. Find the average length of the remaining 8 sticks.

51. How many boys, earning \$1.10 per day, would earn in 12 dys. as much as 15 men would earn in 22 dys. at \$1.40 per day?

52. If 400 meters equal $\frac{1}{4}$ of a mile, how many square meters are there in $\frac{1}{4}$ of an acre?

53. If 2 cu. in. of mercury weigh 1 lb., and 100 cu. in. of air weigh 31 grs., how high must a column of air be to weigh as much as a column of mercury 29.388 in. high, standing on a base of the same area? Give the answer in miles and yards.

54. A ship-owner insures his ship so that in the event of loss he may recover the value of the ship and the premium. The vessel is worth \$64,350, and the premium is $2\frac{1}{2}\%$. Find the amount for which he must insure, and the premium he must pay.

55. A puts \$5000 into a business, and B \$6000, the partnership dating from Jan. 1, 1884. On May 26, B withdraws $\frac{2}{5}$ of his capital. The whole profits for the year amounted to \$573.68. What was B's share?

56. Find the difference between the simple and the compound interest on $\$5208\frac{1}{3}$ for 4 yrs. at 5%.

57. If 1 lb. Troy of silver is worth \$13.20, and if $2\frac{1}{5}$ lbs. avoirdupois equal 1 kilogram, find the value of a lump of silver weighing 2.64 kilograms.

58. The average age of the boys in four classes is 18.4, 17.9, 17.7, 17.8 yrs., and the numbers respectively are 29, 33, 33, 34. Find the average age of the whole number of boys.

59. What is the greatest interval of time which is contained an integral number of times in 22 dys. 11 hrs. 15 min. 3 sec. and in 35 dys. 7 hrs. 23 min. 39 sec.?

60. Find the cost of papering the walls of a room 30 ft. 6 in. long by 21 ft. 4 in. wide, and 10 ft. 6 in. high, with paper 1 ft. 9 in. wide at 60 cents per roll of 10 yds., allowing 250 sq. ft. for windows, etc. Also find the cost of painting the ceiling at 10 cents per square yard.

61. An agent is allowed 8% commission for selling pianos, on condition of his making good any bad debts. If he sell 367 pianos at an average price of \$170.54 each, and the bad debts amount to \$59.53, what clear profit does he make?

62. What must be the price of a stock paying $7\frac{1}{2}\%$ per annum, so that a man may take it in exchange for a 4% stock worth $112\frac{1}{2}$ without altering his income, allowing $\frac{1}{8}\%$ brokerage both in selling and in buying?

63. If the planet Venus and the earth revolve round the sun in 224.7 dys. and 365.25 dys. respectively, at what intervals will the three bodies be in a straight line?

64. Simplify $\dfrac{1\frac{5}{11} \text{ of } (4\frac{3}{7} + 1\frac{2}{3} - 6\frac{5}{8} - 2\frac{2}{9} + 3\frac{7}{12})}{6\frac{3}{5} \text{ of } \frac{2}{11} \text{ of } \frac{21}{11} - 1\frac{1}{5}}$.

65. A man receives \$8754$\frac{3}{8}$ for the sale of goods upon which he has a commission of 5%. What amount does he clear if his expenses are $15\frac{1}{2}\%$ of his commission?

66. If 0.0645 of a mile be travelled in 0.00301 of an hour, what is the rate in yards per second?

67. If 10 negroes can dig a trench 100 yds. long, 2 yds. wide, and 4 ft. deep in 6 dys. of 8 hrs. each, in how many days of 10 hrs. each will 12 Irishmen dig a trench 80 yds. long, 3 yds. wide, and $2\frac{1}{2}$ ft. deep, an Irishman being supposed able to do $\frac{1}{3}$ as much again as a negro?

68. A pound weight of brass contains 3.3 cu. in., and a pound weight of antimony contains 6.27 cu. in. Find the weight in pounds of a mass of $313\frac{1}{2}$ cu. in., containing equal weights of the two metals.

69. A vertical glass tube contains water and oil. The height of the column of oil is 0.7 of that of the water, which is 25 in. If 16% of the oil be removed, by what per cent is the height of the whole column diminished?

70. For doing a paper of 16 questions, 84 min. are allowed. If a boy spend $1\frac{1}{2}$ min. on the first question, $4\frac{3}{4}$ min. on the second, $6\frac{1}{2}$ min. on the third, and 8 min. on the fourth, what is the average time which he can give to each of the others?

71. If an ore lose 43.2% of its weight in roasting, and 39.5% of the remainder in smelting, how many tons of ore must be raised to produce 50 tons of metal?

72. A pays B five \$100 shares which sell at $10\frac{1}{2}$% premium as the present worth of a note for \$638 due in 1 yr. 4 mos. at 12%. Which gains by the payment, and how much?

73. A grocer buys a barrel of sugar containing 336 lbs. at 5 cents per pound, and 2 bbls. each containing 336 lbs. at 4 cents per pound, and 2 bbls. each containing 392 lbs. at $5\frac{1}{2}$ cents per pound. He then mixes the sugar and sells 1008 lbs. of the mixture at 6 cents per pound. Find the selling price per pound for the remainder, in order that he may gain 42% on his whole outlay.

74. Two trains travelling in opposite directions pass each other in $3\frac{1}{2}$ sec. Their lengths are 261 ft. and 201 ft. respectively. If the first train is travelling at the rate of 50 mi. per hour, what is the rate of the other?

75. One-fourth part of some goods was destroyed by fire, and one-third part of what remained was sold at a loss of 10%. By what per cent must the cost price of the remaining goods be increased, in order that no loss may be sustained?

76. A person wishing to determine the length of an iron bridge, and knowing the velocity of sound in iron to be (roughly) 15 times that of sound in air (1120 ft. per second), places his ear at one end and notices an interval of 0.4 of a second between the two sounds received, one through the air, the other through the iron of the bridge, from a blow at the other end. What is the length of the bridge?

77. If a cubic inch of water converted to steam will produce mechanical force sufficient to raise 2200 lbs. a foot high, how many meters high would the conversion into steam of a cubic centimeter of water raise one kilogram? (Take 1 in. = 2.5 centimeters, and 1 kilogram = 2.2 lbs.)

78. A man owns two houses worth $5930 and $13,275 respectively. If the first rise in value 10%, and the second fall 3%, find the change per cent in the value of his whole property.

79. A can beat B by 6 yds. in 300 yds., and C can beat B by $9\frac{3}{4}$ yds. in 300 yds. By how much will C beat A in a mile race?

80. If pure spirit cost $2.80 per gallon, in what ratio must spirit and water be mixed in order to clear 25% profit by selling the mixture at $2.50 per gallon?

81. If $100 be invested at the beginning of each of 5 yrs. at 5% compound interest, find the total amount at the end of the 5 yrs.

82. If the work of 3 men is equal to that of 5 women, or to that of 7 boys, and if 3 men, 3 women, and 8 boys do $\frac{2}{3}$ of a piece of work in 7 dys., working $8\frac{1}{2}$ hrs. per day, how many days will it take 4 men, 11 women, and 7 boys to finish the work, working 9 hrs. a day?

83. In what proportion should tea at 90 cents per pound and tea at 45 cents per pound be mixed, so that by selling the mixture at 80 cents per pound there should be a gain of 25%?

84. Of three traders, A, B, and C, A sells goods 16% dearer than B, and C 16% cheaper than B. What per cent does one of B's customers lose by dealing with A, and gain by dealing with C?

85. A man finds that he can row 20 mi. down a river in 4 hrs., but that it takes him 6 hrs. to row back again. Find the rate of the stream, and his rate of rowing in still water.

86. If a man pronounce 9 syllables per second, and sound travel 1120 ft. per second, at what distance from a high rock ought he to stand, that the echo may be heard to repeat the last four syllables?

87. A tradesman's price is 20% above what the goods cost him, but he deducts 5% for cash payment. What profit does he make on cash payments?

88. The exact weight of a cubic foot of water being 62.35 lbs., find the error made in calculating the weight of 1000 cu. ft. of water on the supposition that 1 cu. ft. of water weighs $62\frac{1}{2}$ lbs.

89. By selling a mixture of coffee and chicory in the ratio 7 : 3, a grocer gains $22\frac{1}{2}\%$. He then alters the ratio to 11 : 5, and sells the mixture at the same price as before. What does he now gain per cent, supposing the coffee cost him 4 times as much as the chicory?

CHAPTER IX.

THE METRIC SYSTEM.

I. LENGTH.

The names of the units of length, beginning with the largest, are as follows: *kilometer*, *hektometer*, *dekameter*, *meter*, *decimeter*, *centimeter*, *millimeter*.

Abbreviations: *km*, *hm*, *dkm*, *m*, *dm*, *cm*, *mm*.

Each unit is **10** times as large as the next smaller unit.

1. How many millimeters are there in 1^{km}?

2. Reduce 4^{km} to each of the other units.

3. Reduce 8300^{mm} to each of the other units.

4. Reduce 125^{m} to kilometers; to millimeters.

5. Add 2^{km} 28^{m} 40^{cm}; 5254^{dkm} 95^{dm}; 153^{km} 29^{cm}; 1000^{km} $8\frac{1}{2}^{dkm}$. Give the answer in meters.

6. Subtract 4000^{km} 9^{hm} 6^{dm} from $5,145,676^{cm}$. Give the answer in meters.

7. The lengths of two roads are 24^{dkm} 8^{cm} and 2540^{dm} 42^{mm}. How many meters is one road longer than the other?

8. A lady bought 145^{cm} of flannel at \$0.80 per meter, and 3.25^{m} of plush at \$0.52 per decimeter. What was the amount of her bill?

9. Multiply 39^{dkm} 8^{cm} by 9, subtract from the product 25^{hm} 4^{mm}, and give the answer in decimeters.

10. If 10 paces measure 8^{m} 8^{dm}, how many centimeters are there in 2045 paces?

11. By what number must you divide $503,107^{dm}$ in order that the quotient may be 11^{hm}?

II. Surface.

The units of surface are squares whose sides are units of length.

Abbreviations: *qkm*, *qhm*, *qdkm*, *qm*, *qdm*, *qcm*, *qmm*.

Each unit is **100** times as large as the next smaller unit.

In measuring land, the square meter is called a *centar* (*ca*); the square dekameter, an *ar* (*a*); the square hektometer, a *hektar* (*ha*).

12. Reduce 1^{qm} to each of the other units.

13. Reduce 1^{qhm} to each of the lower units.

14. Express $5^{qhm}\ 3^{qdkm}\ 4^{qm}\ 7^{qdm}$ in square meters.

15. Reduce $25{,}000{,}000^{qcm}$ to square hektometers.

16. Reduce 1545.7368 ars to each of the other units.

17. Reduce 39^{qkm} to centars, ars, and hektars.

18. Two fields contain, one 45^{a}, the other 4500^{ca}. Which is the larger field?

19. Add 138^{a} to 3615^{ca}, and give the answer in ars.

20. What must be added to $17{,}453^{qm}$ to obtain $3^{ha}\ 9^{a}$?

21. The area of Paris is about $700{,}000^{a}$, and that of London about 100^{qkm}. What is the difference in ars?

22. What is the difference in hektars between $9{,}674{,}248^{qkm}$ and $5{,}423{,}967{,}400^{a}$?

23. What cost 2.7^{ha} of land at \$0.49 per square meter?

24. What cost $3{,}457{,}675^{qcm}$ of land if 5^{qm} cost \$4.80?

25. If 8.704^{ha} of land cost \$17,451.52, what is the cost of 1^{qkm}? of 1 ar? of 1^{qm}?

26. What costs 1^{qdm} of land if 1128^{a} cost \$16,920?

27. What is the price per centar, if 1^{qkm} is valued at \$20,000,000?

III. VOLUME.

The units of volume are cubes whose edges are the units of length.
Abbreviations: *ckm, chm, cdkm, cbm, cdm, ccm, cmm.*
Each unit is 1000 times as large as the next smaller unit.
In measuring wood, the cubic meter is called a *ster* (*st*).

28. Reduce 1^{cbm} to cubic centimeters.

29. Reduce $640{,}000^{cdm}$ to cubic meters.

30. What part of a cubic decimeter are 200^{ccm}?

31. In making a canal the total amount of earth raised was $1^{ckm}\ 2^{chm}\ 3^{cdkm}\ 7^{cbm}\ 18^{cdm}\ 45^{ccm}$. Express this in cubic meters.

32. $19^{cdkm} + 28{,}000^{cdm} =$ how many cubic meters?

33. Reduce 0.1 of a ster to cubic millimeters.

34. One piece of wood contains 0.1 of a ster, and another piece contains 100^{cdm}; which is the larger?

35. How many cubic centimeters must be added to 0.3^{cbm} to obtain 1319^{cdm}?

36. From 7080^{cbm} take $16{,}756^{cdm}$. Give the answer in cubic meters.

37. What is the cost of $29{,}500^{ccm}$ of box-wood at \$0.55 per cubic decimeter?

38. Three blocks of stone contain, one 3.9^{cbm}, another 1315^{cdm}, the third 0.000002^{cdm}. What will the three blocks cost at \$26.55 per cubic meter?

39. A man buys at one time 90^{cbm} of guano, and at another time $12{,}040^{cdm}$. What is the amount of his bill if 1^{cbm} of guano costs \$7.50?

40. A man buys the following quantities of marble: 9^{cbm}; 1500^{cdm}; 0.000031^{chm}; $170{,}000{,}000^{ccm}$. Find the total cost to him of the marble at \$22.50 per cubic meter.

IV. Capacity.

The units are the *kiloliter, hektoliter, dekaliter, liter, deciliter, centiliter, milliliter.* 1 liter = 1^{dm} = 1000^{ccm}.

Abbreviations: *kl, hl, dkl, l, dl, cl, ml.*

Each unit is **10** times as large as the next smaller unit.

These units are used for measuring liquids, gases, and solids in small pieces (as wheat, potatoes, sand, etc.).

41. Express in liters 316^{hl}; $7^{kl}\ 24^{dkl}$; 4015^{ml}.

42. Reduce $100{,}040^{dl}$ to hektoliters.

43. Express in cubic decimeters the following: $24^{hl}\ 8^{l}$; 22.9^{kl}; $17{,}005^{ml}$.

44. Add 245^{cl}, 4^{hl}, 9^{dkl}, 136^{dl}, and express the result in kiloliters.

45. What is the value in deciliters of 3019 half-liters + 452 double dekaliters?

46. What is the value of $30^{kl} + 225.56^{dkl}$ in cubic meters?

47. How many centiliters in $31{,}675^{ccm} + 2^{hl}\ 65^{dl}$?

48. Reduce $2.25^{kl} + 2045^{ccm}$ to deciliters.

49. Express in hektoliters the value of $0.04^{cbm} + 315^{dl}$ + 50 half-liters.

50. Two casks contain, the first $2^{hl}\ 4^{cl}$, the second $203{,}060^{ccm}$. What is the capacity in liters of both casks?

51. A cooper makes three casks having the following capacities: the first, 0.03^{kl}; the second, 28^{dkl}; the third, 179.25^{cdm}. Find their total capacity in hektoliters.

52. How many cubic centimeters must be added to 0.8^{hl} in order that the sum may be 1.3^{kl}?

53. If 1^{hl} of wine costs \$37.50, what is the cost of 0.08^{kl} + 15 double dekaliters + 7^{dl}?

54. If $24{,}050^{dl}$ of wine are worth \$9740.25, what is the value of 1 dekaliter?

V. Weight.

The units of weight are the *kilogram, hektogram, dekagram, gram decigram, centigram, milligram.*

Abbreviations: *kg, hg, dkg, g, dg, cg, mg.*

Each unit is 10 times as large as the next smaller unit.

1 *gram* = weight of 1^{ccm} of pure water at 4° centigrade.

1 *kilogram* = weight of 1 liter of water. 1 *ton* = 1000 kilograms.

55. Reduce 1^{g} to decigrams, centigrams, and milligrams.

56. Reduce $20^{kg}\ 4^{hg}\ 25^{dg}$ to dekagrams.

57. Reduce 1 ton 30^{kg} to hektograms.

58. What fraction of a kilogram are 50^{dg}?

59. Reduce 60^{kg} to dekagrams, and $26{,}000{,}000^{dg}$ to tons.

60. What is the weight of 1^{dkl} of pure water?

61. What is the weight of 1^{cbm} of pure water?

62. What volume of water in hectoliters will weigh 1908^{kg}?

63. A bar of iron weighs $20^{kg}\ 4^{hg}\ 8^{g}\ 1^{dg}\ 5^{mg}$; express the weight of the bar in grams.

64. Find the value in kilograms of

$$39.28^{kg} + 170^{kg} + 1100^{dkg} + 8^{kg} + 25^{dg}.$$

65. Find in grams the value of

$$22{,}545^{cg} + 20^{kg} + 6^{dkg} + 0.07 \text{ of a ton.}$$

66. How many grams must be added to 8.29^{kg} in order that the sum may be $13^{kg}\ 245^{dg}$?

67. If indigo is worth \$2.25 per half-kilogram, what will be the cost of a quantity of indigo weighing as much as 2.8^{cdm} of pure water?

68. Express in dekagrams the weight of

$$8^{dkl} + 235^{cl} + 450^{ccm} \text{ of pure water.}$$

69. If 2^{kg} of quinine cost \$15.00, what costs 1^{dkg}?

VI. Miscellaneous Exercises.

70. A rope-maker makes $6^{km}\ 4^{hm}\ 3^{dkm}\ 8^{m}\ 4^{dm}\ 2^{cm}\ 5^{mm}$ of rope. How many meters does he make?

71. If 19^{m} of silk cost \$123.50, what is the value of 1 decimeter?

72. Reduce $13{,}000{,}000^{qcm}$ to square dekameters.

73. Two fields contain, the one $457^{qm}\ 8^{qdm}$, the other 0.00075^{qkm}. Which is the larger field? What is the difference in square meters between their areas?

74. If 41.5 ars of land cost \$1045.80, what is the value of 1 square meter?

75. If 51.04^{cbm} of guano cost \$18,119.20, what is the value of 1 cubic centimeter?

76. What is the value of $49{,}000^{ccm} + 39^{cl}$ of olive oil at \$1.75 per liter?

77. A man buys at the rate of \$225 per hektoliter the following quantities of brandy: $1^{hl}\ 6^{cl}$; 14^{dl}; $14{,}040^{ml}$; 0.03^{kl}. What was the total cost?

78. If 1^{l} of oil costs \$1.10, what is the value of

$$500{,}000^{ccm} + 0.24^{cbm} + 4.0008^{hl}?$$

79. Find the value of the following sum in hektograms: 0.4 of a ton $+ 20.029^{kl} + 32{,}144^{cg}$ of water.

80. Two vessels, when empty, weigh $95^{dkg}\ 8^{dg}$ each; full of pure water they weigh, the one 45^{hg}, the other $523{,}415^{cg}$. How many decimeters will one vessel hold more than the other?

81. If a freight train travels 80^{km} in 15 minutes, how far will it go in $5\frac{1}{2}$ hours?

82. If a man pays 10 cents for 25^{cl} of wine and 12 cents for $7\frac{1}{2}^{cl}$ of brandy, what is the value, at the same rate, of 1 liter of each article?

83. If a man's pace has an average length of 0.7^{m}, and he takes 100 paces in a minute, how long will he be in going 28^{km}, supposing that he rests half an hour on the road?

84. The annual production of coal in England is about 32,000,000 tons. What is the volume of this coal in hekoliters, if 1^{hl} of coal weighs 78.5^{kg}?

85. Wood yields about $\frac{1}{3}$ of its bulk of charcoal and about $\frac{1}{5}$ of its weight. If 1 ster of oak wood weighs 735^{kg}, and 1 ster of beech wood weighs 620^{kg}, find the volume and the weight of charcoal furnished by 6 sters of each kind of wood.

86. A fountain furnishes 17^{dl} of water per second. How many hours will be required to fill a tank holding 3^{obm} 9^{odm}?

87. In order to find the capacity of a glass vessel, it may be weighed, first when empty, and then when full of pure water. The difference between these two weights in kilograms will be the same as the capacity of the vessel in liters. Hence find the capacity of a vessel which weighs empty 2.8^{kg}, and full of water $15{,}825^{kg}$.

88. A lot of land containing 63.21^{a}, worth \$0.35 per square meter, is exchanged for another lot containing 1^{ha} 5^{a}. What is the value per ar of the second lot?

89. Light travels from the sun to the earth in 8 minutes 13 seconds. The distance is $153{,}624{,}000{,}000^{m}$. What is the velocity of light in kilometers per second?

90. A bag weighs when empty, 213^{g}, and when full of silver five-franc pieces, 20^{kg} 35^{hg} 13^{g}. A five-franc piece weighs 25^{g}. How many five-franc pieces will the bag hold?

91. What is the value of $28^{\text{qdm}}\ 19^{\text{qcm}}$ of cloth at \$3.50 per square meter?

92. How many square centimeters of surface has a table which is 1.1^{m} long, 0.85^{m} wide?

93. A garden in the shape of a rectangle is 235.08^{m} long and 117.25^{m} wide. Find its value at \$0.22 per square meter.

94. Find what the air in a balloon holding 725.85^{l} weighs, knowing that water is 770 times heavier than air.

95. A vessel weighs when empty 2.7^{kg}, and when full of water 4235^{dkg}. What would it weigh if filled with milk, which is 1.03 times as heavy as water?

96. If milk is 1.03 times as heavy as water, and yields 15% of its weight in cream, and the cream yields 25% of its weight in butter, how many liters of milk are required to make a kilogram of butter?

97. A landowner was offered \$40,000 for a lot containing 3.25 ars. He refused the offer. The land appraisers then allowed him \$124 per square meter. Did he gain or lose by refusing the offer, and how much?

98. Sound travels 340^{m} per second. How far is a cannon from a man who hears the report 13 seconds after seeing the flash, assuming that light travels the distance instantaneously?

99. If 34.19 ars of land are worth \$1540, what is the value of 237.21^{qm}?

100. What is the price of a block of Carrara marble 2.6^{m} long, 1.85^{m} wide, and 0.95^{m} thick, at \$2.45 per cubic decimeter?

101. What is the cost, at \$3.75 per ster, of a pile of wood having the following dimensions: length, 6.5^{m}; breadth, 2.3^{m}; height, 1.25^{m}?

102. Four vineyards furnish, the first, 1300^{dkl} of wine; the second, $1^{cbm}\ 8^{l}$; the third, $25{,}143^{dl}$; the fourth, $15{,}000{,}000^{ccm}$. Find the value of the entire quantity at \$7.25 per double dekaliter.

103. If 1^{dkl} of walnuts yields 1^{l} of oil, how much oil can be extracted from $4.08^{cbm} + 672^{l}$ of walnuts, and what is it worth at \$0.85 per half-liter?

104. If $6^{hl}\ 1^{dl}$ of Rhine wine are worth \$480, what is the value of 1 dekaliter?

105. An empty vessel weighs $27^{kg}\ 35^{dg}$, and full of pure water, it weighs 243^{kg}. What is its capacity in dekaliters, and in cubic decimeters?

106. At the rate of \$1.50 per kilogram, what is the price of $8135^{dg} + 143^{dkg}$ of tea?

107. A trader buys at one time 9.85^{kg} of nut oil, and at another time $1{,}345{,}675^{mg}$. Find the cost of the whole at \$0.19 per hektogram.

108. A druggist buys 3 boxes of fancy soap. The first box weighs 75.25^{kg}; the second 80.39^{kg}; the third 90^{kg}. The empty boxes weigh 13.85^{kg}. What is the cost of the soap at $88\frac{1}{2}$ cents per kilogram?

109. If 0.002 of a ton costs \$15.75, find the price of a dekagram.

110. If $13^{kg}\ 6^{dkg}$ costs \$105.133, find the price of a hektogram.

111. The weight of a body floating in a liquid is equal to the weight of the liquid displaced. What is the weight of a block of wood 1.6^{m} long and 0.3^{m} wide, which, lying horizontally in the water, sinks to a depth of 0.12^{m}?

112. A pile of wood containing 20.88 sters is 4.8^{m} long and 2.9^{m} wide. What is its height?

113. A silver five-franc piece weighs 25^{g}, and is composed of 9 parts pure silver and 1 part pure copper. A silver two-franc piece weighs 10^{g}, and is composed of 835 parts of pure silver and 165 parts pure copper. A silver twenty-centime piece weighs 1^{g}, and has the same composition as the two-franc piece. Find the total weight of pure silver and of pure copper contained in 272 pieces of five-francs, 145 pieces of two-francs, and 179 pieces of twenty-centimes. Find also the total value, knowing that 100 centimes = 1 franc.

114. A pile of wood 5.6^{m} long, 3.7^{m} wide and 1.85^{m} high, supplies 4 fires. How long will it last, if each fire consumes 0.045 of a ster per day?

115. What will it cost at the rate of \$4.55 per 100 kilograms, to send 102,850 francs in silver five-franc pieces from Paris to Canton? (See Ex. 113).

116. A floor, 5.4^{m} long and 4.25^{m} wide, is paved with square tiles 0.16^{m} long, and costing \$32.50 per thousand. Find the cost of the tiles.

117. If 1^{ccm} of a certain oil weighs 925^{mg}, what is the value of $54^{dkl}\ 7^{dl}$ of the oil at \$1.95 per kilogram?

118. If a hektoliter of coal weighs 87.5^{kg}, what sum will be obtained by selling 298^{cbm} of the coal at \$5 per ton?

119. If a hektoliter of olive oil weighs 91.5^{kg}, and costs \$120.25, what is the value of 1^{kg}? also of 1 liter?

120. If 1^{hl} of coal yields 1854^{cbm} of gas, and 1 burner consumes 139^{l} of gas in an hour, how many hektoliters of coal are required to supply 2600 burners going for 1440 hours?

121. A wheat-field contains 13.79^{ha}, and yields 301^{hl} of wheat, which is sold at the rate of \$7.03 for 120^{kg}. One hektoliter of wheat weighs 76^{kg}. How much wheat is obtained from each square dekameter, and what is its value?

122. A wood-lot contains $35^{ha}\ 7^{a}\ 4^{ca}$ of land, and it is estimated that the quantity of wood will average 122 sters per hektar. Upon this basis find the value of the wood at \$4.10 per ster.

123. If 26^{kg} of flour yields 35^{kg} of bread, and 1^{dkl} of wheat yields 6^{kg} of flour, find (1) how many hektoliters of wheat in one year a family of 6 persons will require, if each person on the average eats 7^{hg} of bread per day; (2) the daily cost of the bread for the family, if 1^{hl} of wheat costs \$3.72.

124. A grocer buys 3 boxes of fancy soap weighing, the first $210^{kg}\ 7^{dkg}$; the second $23{,}500^{dkg}$; the third 0.37 of a ton. The empty boxes weigh 7.25^{kg}. The price paid is \$17 for 100^{kg} of soap. Find the total weight of the soap and its cost.

125. A certain gas-burner consumes, on the average, 120^{l} of gas per hour. Find the cost of lighting a room for 3 months, if there are 4 of these burners, and the room is lighted for 2 hours on 20 evenings during each month, and the gas costs \$0.07 per cubic meter.

126. How much silver must be combined with 897^{g} of copper, to form an alloy suitable for making five-franc pieces? (See Ex. 113.) Find the number of francs that can be made from the alloy.

127. By selling spice at \$4.25 per kilogram which cost \$0.372 per hektogram, a merchant makes a profit of \$66.25. How many kilograms of spice did he sell?

128. A rectangle is 123.2^m long and 74.6^m wide. Find its area (1) in square dekameters, (2) in centars.

129. Find in ars the areas of four rectangles whose dimensions are as follows: the first 0.25^m and 0.07^m; the second 49.03^m and 29.9^m; the third 135.85^m and 94.06^m; the fourth 210.42^m and 115.7^m.

130. The base of a triangle measures 136.25^m, and its altitude 48.2^m. Find its area.

131. Find the altitude of a triangle, if the base is 82^m, and the area 51.373 ars.

132. The bases of a trapezoid are 83.45^m and 57.55^m respectively; the altitude is 33.6^m. Find the area.

133. The diagonals of a rhombus are 8.6^m and 6.85^m respectively. Find the area.

134. Find the area of a circle the radius of which is 18^m (take $\pi = 3.1416$).

135. The radius of a circle is 0.75^m. Find the circumference and the area (take $\pi = 3.1416$).

136. Find the area of a triangular field whose base is 950.75^m and altitude 357.8^m.

137. If the area of a rectangular field is 95.8016 ars, and the base is 107.2^m, what is the altitude?

138. A rectangular field is 278^m long and 112.85^m wide. I wish to take from one end of the field a rectangular lot that shall contain 78 ars. What will be its width, and what will be the area of the remainder of the field?

139. What is the altitude of a field in the shape of a trapezoid the sum of whose bases is 231^m and whose area is 0.924^{ha}?

140. If a hektar yields $23\frac{1}{2}^{hl}$ of wheat, what is the yield of a rectangular field 187.65^{m} long and 135.2^{m} wide?

141. What is the volume of a cube whose edge is 2.35^{m}?

142. What weight of water will a rectangular tank hold, if its length is 1.6^{m}, its breadth 1.25^{m}, and its depth 0.85^{m}?

143. The base of a cistern has an area of 22.4^{qm}, and the cistern will hold, when full, $56{,}000^{kg}$ of water. What is the depth of the cistern?

144. What is the price of 4 oak beams, each 10.8^{m} long, and 0.45^{m} square at the end, and sold at the rate of \$30 per cubic meter?

145. A pile of wood is made between two posts 0.82^{m} apart. The sticks are 1.25^{m} long. What must be the height of the pile in order that it may have a volume of 1 ster?

146. The mean depth of a pond is 1.8^{m}, and it occupies a surface of 3.4 hektars. How many cubic meters of water does the pond contain when full?

147. A heavy rain caused the water in a cistern 5.4^{m} long and 2.6^{m} wide to rise 0.53^{m}. How many liters of water fell into the cistern?

148. Find the volume of a cylinder whose height is 5.38^{m}, and the diameter of whose base is 2.4^{m} (take $\pi = 3.1416$).

149. Find the volume, in cubic decimeters, of a cylinder whose height is 0.53^{m} and the circumference of whose base is 155^{cm} (take $\pi = 3.1416$).

150. The radius of a cylindrical log is 0.25^{m} and its length is 2.15^{m}. Find its volume in sters (take $\pi = 3.1416$).

151. A cylindrical vessel, the circumference of whose base is 2.2^{m} and whose height is 2.1^{m}, is four-fifths filled with pure water. Find the weight of this water (take $\pi = 3.1416$).

152. Find the height of a square pyramid if a side of the base is 3.05^{m} and the volume is 37.21^{cbm}.

153. Find the surface of a sphere whose diameter is equal to 1.8^{m} (take $\pi = 3.1416$).

154. Find the volume of a sphere whose radius is equal to 23.5^{m} (take $\pi = 3.1416$).

155. Find the diameter of a sphere whose volume is equal to 240^{cbm} (take $\pi = 3.1416$).

156. If the circumference of a cannon-ball is 52^{cm}, find the surface and volume of the ball (take $\pi = 3.1416$).

157. The meter was originally defined as $\frac{1}{10000000}$ of the distance from the equator to the north pole. Taking the circumference of the earth to be 24,855 mi., find the value of 1^{m} in inches, correct to four decimal places.

158. Reduce 236 mi. to kilometers ($1^{km} = 0.6214$ mi.).

159. If the height of a barometer is 76^{cm}, and we take 1^{m} as equal to 39.37 in., find the height of the barometer in inches.

160. On a map of France drawn to the scale $\frac{1}{800000}$ the distance between two cities is 16.734 in. Taking 32^{m} as equal to 35 yds., find to the nearest kilometer the actual distance between the cities.

161. If 1 oz. $= 28.35^{g}$, how many kilograms are there in 1 avoirdupois ton?

162. One gallon contains 231 cub. in. Taking 1 in. as equal to $2\frac{1}{2}^{cm}$, find the weight in grams of a gallon of water.

163. A merchant imports 20^{kl} of wine, which he wishes to put into quart bottles. Deducting 5% of the wine as waste, how many bottles are required? ($1^{l} = 0.261475$ gal.)

MATHEMATICAL TEXT-BOOKS

By G. A. WENTWORTH, A.M.

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EXAMINATION MANUALS.

No. I.

ARITHMETIC.

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PREFACE.

THIS Manual consists of two parts: The first part contains one hundred and fifty examination papers, the questions for which have been selected mainly from the English, French, and German collections of problems. These papers may be divided into three groups. The first fifty papers are confined to the Simple Rules, Fractions, and Weights and Measures; the next fifty papers cover all the subjects treated in ordinary text-books except the Metric System; the last fifty also include the Metric System.

In each group the earlier papers will be found somewhat easier than the later ones. The papers are intended to be *hour* papers, but if any of them are thought to be too long for one hour, the time may be increased, or the length of the paper reduced by omitting one or more questions.

The second part of the Manual is a collection of recent examination papers actually set in various American and English institutions of learning.

The Manual may be used in two ways.

First: To *test* the learner's knowledge in the usual way by means of an examination. For this purpose the class will come to the recitation-room provided with the Manual and blank books, and the teacher will simply designate by number the paper to be worked.

Secondly: To *review* the subject-matter of Arithmetic. This may be done by assigning problems to be worked in the class-room,

or by assigning to each pupil a paper with directions to hand in the solutions, neatly worked out, at a subsequent recitation.

The Manual will be found especially useful in preparing for written examinations.

Answers to the problems in the first one hundred and fifty papers, bound separately in paper covers, can be had by teachers *only*, on application to the publishers.

G. A. WENTWORTH.
G. A. HILL.

SPECIMEN PAPER WORKED OUT.

1. In 674,381 inches how many miles, furlongs, rods, etc.?

12)674381 in.
3)56198 ft. 5 in.
18732 yds. 2 ft.
2
11)37464 half-yds.
40)3405 rds. 4½ yds.
8)85 fur. 5 rds.
10 mi. 5 fur.

10 mi. 5 fur. 5 rds. 4½ yds. 2 ft. 5 in.

Ans. 10 mi. 5 fur. 5 rds. 5 yds. 0 ft. 11 in.

2. Find the G.C.M. of 269,178 and 352,002.

6)269178 352002
44863)58667(1
44863
4)13804
3451)44863(13
3451
10353
10353

Ans. $6 \times 3451 = 20{,}706$.

The common factor 6 is first taken out from both numbers. From the remainder 13,804, the factor 4, which is prime to 44,863, is ejected. The resulting number 3451 is contained 13 times in 44,863, and therefore the greatest common measure is $6 \times 3451 = 20{,}706$.

3. Simplify $\dfrac{\frac{1}{3}+\frac{2}{11}+\frac{7}{24}-\frac{1}{3}\text{ of }\frac{2}{11}\text{ of }\frac{7}{24}}{1-\frac{1}{3}\text{ of }\frac{2}{11}-\frac{2}{11}\text{ of }\frac{7}{24}-\frac{7}{24}\text{ of }\frac{1}{3}}$.

$$\frac{1}{3}\text{ of }\frac{\cancel{2}}{11}\text{ of }\frac{7}{\underset{12}{\cancel{24}}}=\frac{7}{396};$$

$$\frac{1}{3}+\frac{2}{11}+\frac{7}{24}-\frac{7}{396}=\frac{264+144+231-14}{792}=\frac{625}{792};$$

$$\frac{1}{3}\text{ of }\frac{2}{11}=\frac{2}{33};\quad \frac{\cancel{2}}{11}\text{ of }\frac{7}{\underset{12}{\cancel{24}}}=\frac{7}{132};\quad \frac{7}{24}\text{ of }\frac{1}{3}=\frac{7}{72};$$

$$1-\frac{2}{33}-\frac{7}{132}-\frac{7}{72}=\frac{792-48-42-77}{792}=\frac{625}{792};$$

$$\frac{625}{792}\div\frac{625}{792}=1.$$ *Ans.* 1.

4. Divide 0.025 by 500, and 0.03625 by 0.29.

$$\begin{array}{r} 5\cancel{00})\,0.025\cancel{00} \\ \hline 0.00005 \end{array} \qquad \begin{array}{r} 0.125 \\ 29\overline{)3.625} \\ \underline{29} \\ 72 \\ \underline{58} \\ 145 \\ \underline{145} \end{array} \qquad \left.\begin{array}{r} 0.00005 \\ 0.125 \end{array}\right\}.$$ *Ans.*

5. Make out the following bill:

$3\frac{1}{4}$ pounds of tea at 64 cents per pound;
$1\frac{1}{2}$ pounds of coffee at 40 cents per pound;
$6\frac{1}{2}$ pounds of loaf sugar at 10 cents per pound;
$1\frac{1}{2}$ pounds of butter at 34 cents per pound.

How much change out of \$5 should Mr. Smith receive?

Mr. John Smith,

Dr. to James Horn.

1883. Aug. 17.	$3\frac{1}{4}$ lbs. of tea	@ 64 cts.	\$2.08
	$1\frac{1}{2}$ lbs. of coffee	@ 40 cts. . . .	.60
	$6\frac{1}{2}$ lbs. of sugar	@ 10 cts. . . .	.65
	$1\frac{1}{2}$ lbs. of butter	@ 34 cts. . . .	.51
			\$3.84

Received payment,

Ans. \$5.00 − \$3.84 = \$1.16. James Horn.

6. If 18 men can dig a trench 200 yards long, 3 yards wide, and 2 yards deep, in 6 days of 10 hours each, in how many days of 8 hours each will 10 men dig a trench 100 yards long, 4 yards wide, and 3 yards deep?

Men, 10 : 18 :: 6 days.
Length, 200 : 100
Width, 3 : 4
Depth, 2 : 3
Hours, 8 : 10

$$\frac{\cancel{18}^{9} \times \cancel{100}^{1} \times \cancel{4}^{2} \times \cancel{3}^{1} \times \cancel{10}^{1} \times \cancel{6}^{3}}{\cancel{10}^{1} \times \cancel{200}^{2} \times \cancel{3}^{1} \times \cancel{2}^{1} \times \cancel{8}^{2}} = \frac{27}{2} = 13\tfrac{1}{2}.$$

Ans. 13½ days.

7. What alteration will be made in an income by selling $10,000 of 4 per cent stock at 89¼, and buying 5 per cent stock at 105?

Income from 4 per cent stock = 0.04 of $10,000 = $400.
Proceeds of 4 per cent stock = 0.89¼ of $10,000 = $8925.
$1 of 5 per cent stock costs $1.05; therefore,
Amount of 5 per cent stock = $8925 ÷ 1.05 = $8500.
Income from 5 per cent stock = 0.05 of $8500 = $425.
Increase in income = $425 − $400 = $25.

8. A room measures 16 feet by 21 feet, and is 11 feet high. There is one door 7 feet by 3 feet, and two windows 8 feet by 4 feet. Find the cost of papering it with paper 2 feet wide at 5 cents a yard.

Distance round the room = 16 + 16 + 21 + 21 = 74 ft.
Area of walls of room = 11 × 74 = 814 sq. ft.
Area of door and windows = 21 sq. ft. + 64 sq. ft. = 85 sq. ft.
Area to be papered = 814 sq. ft. − 85 sq. ft. = 729 sq. ft.
Area of one yard of paper = 3 × 2 = 6 sq. ft.
Number of yards required = 729 ÷ 6 = 121½.
Cost of the paper = 121½ × $0.05 = $6.07½.
Ans. $6.07½.

9. A jar full of water weighs 1.325^{kg}; filled with mercury it weighs 12.540^{kg}. What is the capacity of the jar, and its weight? The specific gravity of the mercury is 13.59.

$$\begin{array}{r} 12.540 \\ 1.325 \\ \hline 11.215^{kg} \end{array} \qquad \begin{array}{r} 13.59 \\ 1 \\ \hline 12.59^{kg} \end{array} \qquad \begin{array}{r|l} & 0.89078^{l}. \\ \hline 12.59 & 11.215 \\ & 10072 \\ \hline & 11430 \\ & 11331 \\ \hline & 9900 \\ & 8815 \\ \hline & 10870 \end{array}$$

Mercury in jar weighs 11.215^{kg} more than water in jar.

A liter of mercury weighs 12.59^{kg} more than a liter of water.

Capacity of jar $= \frac{11.215}{12.59}$ of a liter $= 0.89078^{l}$.

Weight of water in jar $= 0.89078^{kg}$.

Weight of jar $= 1.325^{kg} - 0.89078^{kg} = 0.43422^{kg} = 434.22^{g}$.

Ans. 0.89078^{l}; 434.22^{g}.

10. Extract the cube root of 5 to five places of decimals.

$$\begin{array}{rl|l} & & 5.000(1.70997 \\ & & 1 \\ \hline 3\times 10^2 = & 300 & 4\,000 \\ 3(10\times 7) = & 210 & \\ 7^2 = & 49 & \\ & 559 & 3\,913 \\ & 259 & \\ \hline & & 87\,000\,000 \\ 3\times 1700^2 = & 8670000 & \\ 3(1700\times 9) = & 45900 & \\ 9^2 = & 81 & \\ & 8715981 & 78\,443\,829 \\ & 45981 & \\ \hline & & 8\,556\,171\,0 \\ 3\times 1709^2 = & 8762043 & 7\,885\,838\,7 \\ \hline & & 670\,332\,30 \\ & & 613\,343\,01 \\ \hline & & 1.70997 = \textit{Ans.} \end{array}$$

For explanation of the method, see Wentworth and Hill's Practical Arithmetic, page 282.

EXAMINATION MANUAL.

ARITHMETIC.

1.

1. Write in words 15,006,021, and state how many times a number is increased by annexing three ciphers to it.
2. Multiply 2,035,674 by 3096.
3. Divide 275,487 by 736, and prove that the result is correct.
4. How many times is 195 yards 1 foot 8 inches contained in a mile?
5. Find the number of cubic inches in 1 cubic yard 24 cubic feet 760 cubic inches.
6. How many grains of gold in a cup weighing 8 ounces 4 pennyweights?

2.

1. How much must be added to sixty million four hundred six thousand two hundred ninety to make three hundred twenty million?
2. Multiply 456,978 by 789.
3. Divide three hundred thirty-seven million one hundred three thousand twenty-five by eight hundred sixty-one.
4. In 674,381 inches how many miles, rods, feet, and inches?
5. Find the difference between 30 years 8 months 3 weeks 6 days and 44 years 3 months 1 week 5 days.

3.

1. Write in words the sum of 4,300,702; 6,070,506; and 341,318.
2. Find the number which, subtracted from 80,000, leaves 57,735.
3. From the sum of eight million seventy-nine thousand six hundred ninety, and three hundred eighty-five thousand seven hundred nine, subtract their difference.
4. Divide 19,094,867 by 4009.
5. The circuit of a race-course is 137½ yards. How many times must a bicyclist go round to complete 5 miles?
6. Take 156 miles 160 rods 216 yards from 191 miles 80 rods 2 yards.

4.

1. Write in figures two million twenty thousand eighty-seven.
2. Express in words and in figures the excess of the value of one 5 over the other in the number 658,457.
3. Multiply seventeen thousand nine hundred forty-three by five thousand seventy-nine.
4. Divide five hundred one million five hundred by three thousand eight hundred fifty.
5. Reduce 125 square rods 23 square yards 6 square feet 108 square inches to square yards.
6. How many grains in a pound Avoirdupois? in a pound Troy?

5.

1. Write in figures ten million eighty-three thousand six hundred eighty.
2. Divide the product of 37,800 and 7950 by 630.
3. What number multiplied by 6702 will give 218,773,386?
4. How often is £1 17*s.* 6*d.* contained in £28 2*s.* 6*d.*?
5. An engine draws a train of 23 cars, each containing 5 long tons, 2123 pounds of coal. What is the weight of coal in the train?
6. A square drill-yard required 869 square slabs, each measuring 3 square feet 86 square inches. What is the area of the yard in square feet, etc.?
7. Required the weight of a guinea, if 45 can be coined from a pound of gold.

6.

1. A person walked 136 miles in 40 hours 48 minutes. How many minutes was he in walking a mile?
2. How many times must we take the number 7 to make 819?
3. By how much does the thirty-seventh part of three thousand six hundred sixty-three fall short of a hundred?
4. Reduce 7,896,432 grains Troy to pounds.
5. If 56 acres of land cost $700, what will be the value of 13 acres 80 square rods?
6. A man agreed to buy a haystack, paying $30 for each load. He found his wagon held 1 ton 392 pounds, and that the whole stack weighed 10 tons 1288 pounds. How much has he to pay?

7.

1. Find the circumference of a carriage wheel which revolves 1848 times in a journey of 3½ miles.

2. In 120,505 square feet how many acres, etc.?

3. If the moon moves forward in her orbit 57° 13′ 18″ in 13 days, find the distance she averages a day.

4. A man can buy a white hat, which lasts 4 months, for $0.75; he can buy a black hat, which lasts 9 months, for $1.75. Which is the cheaper? What is saved in 3 years by wearing the cheaper hat?

5. Find the number of pounds Troy equal to 78 pounds 4 ounces Avoirdupois.

6. Reduce 1 acre 91 square rods 2 square yards to square inches.

8.

1. Reduce 100,196,196 square inches to acres, etc.

2. Reduce 40 pounds 8 ounces 5 drams 1 scruple 7 grains to grains, Apothecaries' weight.

3. Find the cost of half an acre of ground at 63 cents per square yard.

4. The distance between two towns is 18 miles 40 rods 44 yards. How many telegraph poles will be required between them, the poles being 8 rods apart?

5. If $328 equal £74 2*s.* 10*d.*, by how many pence does a dollar exceed 4 shillings?

6. How many cubic yards, feet, and inches in 175,983 cubic inches?

9.

1. In 36,845,371 ounces Avoirdupois, how many long tons, cwts., etc.?
2. In 1,749,134 seconds how many weeks, days, etc.?
3. The latitude of St. Paul's in London is 51° 30′ 49″, and that of St. Peter's in Rome, 41° 53′ 54″. What is one-fifth of the difference of their latitudes?
4. Reduce 875,679 chains 25 links to miles, rods, etc.
5. Reduce 7658 square chains 625 square links to acres, square rods, etc.
6. Change 35 pounds 8 ounces 7 pennyweights 17 grains Troy to Avoirdupois weight.

10.

1. Express in figures nine thousand, seventeen million, fifty-nine thousand ninety-six.
2. How many days will 9867 pounds of hay last 13 horses, if each horse eats 33 pounds a day?
3. A boy has a bag containing 2360 chestnuts; he takes out 7 dozen for himself, and then divides the rest among 19 school-fellows, keeping those remaining over. How many chestnuts did he then have, and how many did each of the other boys have?
4. A city containing 758,043 inhabitants has 5 districts. The population of the first is 78,967; of the second, 139,753; of the third, 145,069; the other two districts have each an equal number of inhabitants. Find the population of each of these two districts.
5. Reduce 367 acres 155 square rods 25 square yards 8 square feet 74 square inches to square inches.
6. Reduce 1,186,126 inches to miles, etc.

11.

1. Reduce 2 miles 3 furlongs 20 rods 1 yard to inches.

2. What do 12 dozen chains weigh, if each contains 2 ounces 9 pennyweights 3 grains of metal?

3. Find the greatest common measure of 203 and 2291.

4. Find the least common multiple of 12, 21, 28, 30, 35.

5. Multiply $\frac{3}{11}$ of $1\frac{2}{3}$ by $5\frac{1}{3}$ of $\frac{1}{4}$.

6. Add together 0.0023, 2.36, 250, 0.527.

7. Reduce 3 quarts 1 pint to the decimal of a gallon.

12.

1. Reduce 1 furlong 15 rods 1 foot 6 inches to yards.

2. If a person spends $2226.50 a year, how much does he spend each day in an ordinary year?

3. Find the greatest common measure of 2163 and 504.

4. Find the least common multiple of 18, 16, 63, 24, 56.

5. Find the value of $2\frac{1}{5} \times 1\frac{5}{6}$ of $1\frac{2}{13} \times 3\frac{1}{4}$ of $1\frac{5}{11}$.

6. Subtract 2.03 from 20.2.

7. Find the value of 0.625 of a gallon.

13.

1. Reduce 357,000 inches to miles, furlongs, rods, etc.
2. At a festival 23,760 persons entered the enclosure between 10 A.M. and 4 P.M. What was the average per minute?
3. Find the greatest common measure of 5292 and 1520.
4. Find the least common multiple of 4, 9, 16, 28, 42.
5. Divide $5\frac{1}{4}$ by $\frac{3}{5}$.
6. If I sell $\frac{5}{8}$ of $\frac{4}{9}$ of an estate, what part of the estate have I left?
7. Multiply 3.26 by 1.02.

14.

1. A dozen persons hire an omnibus for $9.25. How much more must each pay than if there were fifteen?
2. Find the greatest common measure of 3575 and 4719.
3. Find the least common multiple of 6, 15, 18, 35, 72.
4. Divide $20\frac{5}{14}$ by $17\frac{1}{12}$.
5. Find the value of $\frac{5}{8}$ of an acre.
6. Divide 998.824392 by 0.018.
7. Reduce 5 ounces 12 pennyweights 16 grains to the decimal of a pound.

15.

1. Find the greatest common measure of 5292 and 8316.

2. Find the least common multiple of 8, 12, 18, 24, 27.

3. Add together $\frac{2}{5}$, $\frac{1}{6}$, $\frac{7}{8}$.

4. Find the value of $\frac{33}{114}$ of a bushel.

5. Divide 2 weeks 3 days by $3\frac{3}{4}$.

6. Divide 160.68 by 3.9.

7. Reduce 3 quarters 3 pounds 2 ounces 2.816 drams to the decimal of a long ton.

16.

1. Find the greatest common measure of 731, 2329, and 3502.

2. Find the least common multiple of 3, 8, 17, 40, 153.

3. Add $\frac{2}{3}$, $\frac{5}{8}$, $\frac{7}{10}$, $\frac{8}{15}$.

4. Which is the greater $\frac{1}{3}$ of 4 or $\frac{1}{4}$ of 5, and by how much?

5. Find the value of $2\frac{2}{3}$ of 5 bushels + $1\frac{1}{3}$ of $2\frac{1}{2}$ pecks.

6. Divide 0.3964 by 0.75.

17.

1. Reduce $\frac{5}{6}$ of a pound Troy to the fraction of a pound Avoirdupois.

2. Divide 52 by 3.2.

3. Express 0.305 as a common fraction in its lowest terms.

4. Add together $2\frac{2}{3}$, $4\frac{1}{6}$, $3\frac{5}{12}$.

5. Find the greatest common measure and least common multiple of 125, 175, 225.

6. Divide $\frac{2}{3}$ of $\frac{1}{3}$ by $\frac{5}{7}$ of $\frac{3}{5}$.

18.

1. Which is the greater $\frac{3}{5}$ of $1\frac{1}{5}$ or $\frac{1}{7}$ of $5\frac{1}{4}$, and by how much?

2. Simplify $2\frac{1}{2} + \frac{3}{4}$ of $5\frac{1}{2} + 4\frac{7}{11} + 5$.

3. Add together $\frac{5}{6}$ and $2\frac{3}{5}$, and subtract their sum from 4.

4. Multiply 0.026 by 3.3; by 0.33; by 33; and by 0.033.

5. Divide 1.8 by 500.

6. Express 0.0075 as a common fraction in its lowest terms.

19.

1. Add together $3\frac{1}{2}$ of $1\frac{1}{5}$ and $2\frac{2}{5}$ of $1\frac{1}{6}$.

2. Subtract $\frac{2}{3}$ of $1\frac{1}{2}$ from $\frac{1}{2}$ of $2\frac{2}{3}$.

3. Reduce to a simple fraction $\frac{8\frac{3}{4}}{5\frac{5}{8}}$.

4. Divide 611 by 0.13.

5. Reduce 7.2 feet to the decimal of a rod.

6. Find the value of 0.065 of an acre.

7. Reduce $\frac{18488}{80083}$ to its lowest terms.

20.

1. Subtract $\frac{5}{6}$ from $\frac{6}{7}$; $\frac{6}{7}$ from $\frac{7}{8}$; and $\frac{7}{8}$ from $1\frac{1}{9}$; and add together the results.

2. Multiply 2 yards 1 foot $7\frac{4}{5}$ inches by $\frac{11}{18}$.

3. Reduce $\frac{8}{11}$ of a pint to the fraction of a gallon.

4. Divide 2175.68 by 100.

5. Reduce $\frac{108}{125}$ to its equivalent decimal fraction.

6. Reduce 15 square rods to the decimal of one-half an acre.

7. Find the value of 0.009943 of a mile.

21.

1. Find the value in English money of 1572.4185 francs, when the exchange is at 26.675 francs per pound.

2. Divide 101 by 1.01, and 0.101 by 10.1.

3. Reduce 14 hours 15 minutes to the fraction of $3\frac{1}{2}$ days.

4. Reduce to a simple fraction $\frac{10 \times \frac{1}{7}}{3 + \frac{2}{7}}$.

5. Find the greatest common measure and least common multiple of 144, 176, 272.

6. How many plots of $2\frac{1}{2}$ acres each can be made out of an estate one mile square?

22.

1. A man steps 2 feet 8 inches at each step. How many steps will he take in 2 miles?

2. Reduce to its lowest terms $\frac{3575}{4719}$.

3. Subtract $121\frac{5}{6}$ from $202\frac{1}{2}$.

4. How can you determine that a number is divisible by 3 without actually dividing by 3?

5. Two pipes together fill a cistern in 1 hour, and one of them alone fills it in $1\frac{1}{2}$ hours. How long will it take the other alone to fill it?

6. Divide 3.52 by 2.2; by 0.22; and by 22.

23.

1. In 640,825 seconds how many weeks, days, etc.?

2. Reduce $\frac{69615}{92872}$ to its lowest terms.

3. Add $16\frac{11}{13}$, $1\frac{19}{39}$, $\frac{2}{3}$, $\frac{7}{26}$.

4. Subtract $3\frac{3}{4}$ from $30\frac{7}{19}$.

5. Find the product of $1\frac{7}{30} \times 3\frac{18}{25} \times \frac{11}{36} \times 11\frac{14}{31}$.

6. If $\frac{7}{12}$ of an estate be worth \$3003, what is the value of the estate?

7. Reduce 213 rods 1 yard 2 feet 6 inches to the common fraction of a mile.

24.

1. Divide 0.05625 by 0.0275.

2. Reduce £3 15*s.* 6.5 *d.* to the decimal of £4.

3. Westminster Hall is 237 feet long by 68 feet wide; Brussels Town Hall, 264 feet by 50 feet. How many more persons could Westminster Hall accommodate than Brussels Town Hall, allowing $\frac{2}{3}$ of a square yard to each person?

4. Simplify $2\frac{5}{63} + \frac{1}{7} \times \frac{4}{9} - 2\frac{1}{3}$ of $(\frac{2}{3} \div \frac{7}{9})$.

5. Multiply $9 - 3\frac{6}{25}$ by $16\frac{2}{3}$ of $1\frac{1}{12}$.

6. Divide $5\frac{5}{18} - \frac{43}{36}$ by $1\frac{2}{7}$ of $8\frac{1}{6}$.

25.

1. Find the value of $\frac{2\frac{3}{4} \text{ of } 3\frac{2}{6}}{2\frac{5}{6}+\frac{1}{2}+\frac{1}{3}}$ multiplied by $\frac{2}{3\frac{1}{3}}$ of 6.

2. Reduce to its lowest terms $\frac{1}{2}\frac{2}{5}\frac{5}{6}\frac{2}{6}\frac{7}{7}$.

3. A can do a piece of work in 10 days, B can do the work in 15 days. In what time can they both do it working together?

4. Arrange in order of magnitude 2.5×0.075; $2.625 \div 7$; 5×0.05.

5. Reduce $0.\dot{9}7\dot{2}$ to its equivalent common fraction.

6. Reduce to a decimal $\frac{2}{1}\frac{2}{6}\frac{2}{6}\frac{2}{5}$.

7. Reduce 0.9 of a pound Avoirdupois to the decimal of 5 pounds Troy.

26.

1. How many cubic inches in a brick that is 9 inches long, 4 inches wide, 3 inches thick?

2. Reduce to a simple fraction $3\frac{1}{7} \times 3\frac{3}{10} \times 2\frac{3}{11} \times 2\frac{5}{22} \times \frac{2}{3\frac{1}{5}}$.

3. What fraction of $\frac{1}{4}$ of a mile is $1\frac{1}{2}$ feet?

4. Reduce $6\frac{5}{6}$ of $365\frac{1}{4}$ days to the fraction of 3 years.

5. Express in figures seventy-three ten-thousandths.

6. Reduce $0.53\dot{6}$ to a common fraction.

7. Divide 0.005868 by 0.036, and arrange the divisor, dividend, and quotient in order of magnitude.

8. Divide 0.5 by 25; 87.5 by 2.5; and 0.055757592 by 0.009207.

27.

1. Divide 10.8528 by 1.02 and express the quotient as a common fraction.

2. Reduce 2.5 gills to the decimal fraction of $3\frac{1}{3}$ gallons.

3. Find the value of 14.1275 acres.

4. What is the value of 40 acres 132 square rods at $37.50 per acre?

5. A railway train goes 200 miles in 8 hours. In what time will it make a journey of 40 miles?

6. How long will a journey of 15 miles 24 rods 3 yards take at the rate of 3 miles 204 rods 3 yards in 56 minutes?

28.

1. A race-horse goes 5 miles in 32 minutes. How long will he be in going 1650 yards?

2. Reduce $\frac{3}{5}$ of $\frac{5}{7}$ of a mile to the fraction of $\frac{6}{7}$ of $\frac{5}{6}$ of 3 miles.

3. Reduce $5.0\dot{1}\dot{8}$ to its equivalent common fraction.

4. Simplify $\dfrac{9\frac{1}{4} - 2\frac{7}{10}}{2\frac{3}{4} + 3\frac{4}{5}}$.

5. Express 2 feet 3 inches as the fraction of $4\frac{1}{2}$ yards.

6. Resolve 18, 16, 36, 44, 45, 48, 63, 121 into their simplest factors, and find their least common multiple.

29.

1. Sound travels at the rate of 1120 feet in a second. How far off is a thunder cloud, when the clap follows the flash of lightning in $10\frac{1}{2}$ seconds?
2. The four sides of a field are 23 chains 19 links, 17 chains 34 links, 6 chains 85 links, 24 chains 62 links. How many yards around the field?
3. Reduce 10,000 square yards to acres, etc.
4. Find the sum of 8 cubic yards 13 cubic feet 1234 cubic inches, 5 cubic yards 14 cubic feet 976 cubic inches, 2 cubic yards 5 cubic feet 854 cubic inches, and 7 cubic yards 10 cubic feet 1012 cubic inches.
5. Express 1 peck 6 quarts 1 pint as the fraction of 6 bushels 1 peck 3 quarts.
6. Express 13 hours 15 minutes 17 seconds as the fraction of 6 days 1 hour 48 minutes 7 seconds.
7. Find the value of $\frac{2}{11}$ of 3 long tons 5 cwt. 101 pounds.

30.

1. There are 7 miles of road in a certain district. If the average width of the road is half a chain, how many acres of land consist of roads?
2. Reduce 1012 quarts to bushels.
3. Reduce 673,856 seconds to days.
4. A dishonest milkman mixes a pint of water with every two quarts of milk. How many gallons will he make in this way out of 20 gallons of pure milk?
5. A well is 18 yards 2 inches deep, and the wheel is 4 feet 2 inches round. How many turns of the wheel will raise the bucket?
6. Express 1 day 1 hour 50 minutes 42 seconds as the decimal of a day.
7. Express in days, hours, etc., the true length of a year, 365.242218 days.

31.

1. Find the least common multiple of 8, 10, 12, 25, 30, 36.

2. Add $\frac{5}{6}$ of a score to $\frac{4}{5}$ of a dozen, and subtract from the result $\frac{2}{3}$ of a hundred. What is the remainder?

3. A cistern can be filled in 20 minutes by one pipe and in 30 minutes by another. In how many minutes will it be filled by both together?

4. Express $1\frac{2}{3}$ of 7 yards 2 feet 9 inches as a fraction of 13 yards 7 inches.

5. A man walked $11\frac{3}{4}$ miles in $3\frac{1}{2}$ hours. How long would he be in going 20 miles at the same rate?

6. Divide 723.6 by 22.5; and 7.236 by 0.0225.

7. Find the value of $3.\dot{5} \times 0.8$.

32.

1. Find the value of $0.\dot{3} \times 0.\dot{2}\dot{7}$.

2. If $\frac{3}{5}$ of a ton of coal costs $4, what will $1\frac{1}{4}$ cwt. cost?

3. Find the value of 0.2625 of a mile.

4. The highest mountain in the world is Dhawalaghiri, in the Himalayas, and is 28,000 feet above the level of the sea. Express this as a decimal of the earth's radius, 4000 miles.

5. From 1 pound Troy of standard gold are coined 46.725 sovereigns. Find the weight in grains of each sovereign.

6. The depth of a canal is 6 feet 4 inches, the width 19 feet 8 inches, and the length 20 miles. How many cubic feet of water will it hold?

33.

1. Add together $\frac{1}{16}$, $\frac{7}{24}$, $\frac{5}{12}$, and $\frac{3}{8}$.
2. Divide $\frac{7}{15}$ by $6\frac{2}{5}$.
3. Reduce 789,654,328 inches to miles.
4. Reduce £25 16*s.* 8*d.* to the fraction of £15 10*s.*
5. The upper floor of a house is 18 feet 4 inches above the ground and is reached by two equal staircases, separated by the landing of the first floor. How many stairs are there in each staircase, if each stair is 11 inches high?
6. How many hurdles will it take each $5\frac{1}{2}$ feet long to make a square sheep-fold, each side of which is 40 rods?
7. If a quantity of wheat fills 1155 sacks, each holding 8 bushels 4 quarts, how many sacks will it take to contain the wheat when each sack holds 6 bushels 3 quarts?

34.

1. If 64 gallons of wine and 16 gallons of water are mixed, how much wine is there in 2 quarts 1 pint of the mixture?
2. Find the total weight of 5792 iron bars, each weighing 23 pounds 10 ounces.
3. Reduce 0.056 of a square rod to the decimal of an acre.
4. Find the value of 0.58 of a common year.
5. The price of gold being £3 17*s.* $10\frac{1}{2}$*d.* an ounce, find the weight of a nugget worth £341.0925.
6. Find the greatest common measure and least common multiple of 161, 253, 299.
7. Simplify $1\frac{1}{8} + \frac{3}{5}$ of $\frac{10}{9} - \frac{11}{15}$ of $6\frac{1}{4}$.

35.

1. Add 0.60457; 46.70056; 5.80007; and 4.7896.

2. Divide 5.0666 by 21.56.

3. Reduce 2.025 miles to yards.

4. Find the difference between 0.44 of 1 week and 0.125 of 8 days.

5. If the weight of 1 cubic foot of water is $62\frac{4}{25}$ pounds, find the error in calculating the weight of 1000 cubic feet, on the assumption that 1 cubic foot weighs 1000 ounces.

6. Supposing the quick-step in marching to be 2 paces per second, and the length of each pace to be 28 inches, find the time in which a regiment will march 35 miles.

7. Simplify $1\frac{1}{3} - (1\frac{1}{3}$ of $\frac{1}{2})$.

36.

1. Reduce 186 yards 2 feet·8.04 inches to the decimal of a chain (22 yards).

2. Add together $\frac{5}{32}$ of a square mile, $\frac{7}{10}$ of an acre, and $\frac{5}{8}$ of a rood, giving the result in acres, roods, and square rods.

3. Simplify $\frac{1}{3} + 6\frac{1}{2} \times \frac{3\frac{4}{5}}{7} - \frac{1}{3} \times \frac{2}{5}$.

4. Reduce 3 cwt. 14 pounds to the decimal of a long ton.

5. Find the rent of 215 acres 45 square rods at $5.62 an acre.

6. If $4\frac{6}{9}$ ounces Avoirdupois cost $\$8\frac{3}{32}$, what will $8\frac{13}{24}$ pounds cost?

37.

1. If a bankrupt has assets to the amount of $1020, and debts to the amount of $3225, how many cents on a dollar will his creditors receive?

2. Two farmers bought a crop of hay. One took $\frac{5}{8}$ of it, and paid $12. What had the other to pay?

3. In a town of 450 people, 0.44 were men and boys, 0.38 were women and girls, and the rest were children. How many were there of each?

4. If the carriage of $12\frac{1}{4}$ cwt. for 50 miles cost $\$3\frac{9}{24}$, what will it cost to carry $17\frac{1}{2}$ cwt. the same distance?

5. Simplify $(2\frac{1}{2}+\frac{1}{8})\div(2\frac{3}{8}-\frac{1}{8})$.

6. If $\frac{5}{6}$ of a yard cost $\frac{2}{3}$ of $1, what will $11\frac{1}{2}$ yards cost?

7. Divide 7.584057 by 11.7.

38.

1. In 4,076,412 dwts. Troy, how many pounds, ounces, etc.?

2. Divide $100\frac{5}{8}$ by 35.

3. Divide 18,454.9239 by 0.1225.

4. In 17,630,754 square inches, how many acres, etc.?

5. Subtract $8\frac{8}{13}$ from $12\frac{9}{117}$.

6. Subtract 6.04083 from 12.7.

7. A person sold $\frac{2}{3}$ of his estate, bequeaths $\frac{3}{4}$ of the remainder to his son, and leaves the rest to be distributed equally among 3 charities. If each of these charities receives $136.25, what is the value of the estate?

39.

1. Find the value of $\frac{2}{3}\frac{9}{3}$ of a mile.

2. Reduce 2 weeks 2 days $19\frac{1}{3}$ hours to the fraction of a month (4 weeks).

3. Reduce $\frac{5}{1}\frac{9}{8}\frac{9}{0}$ to a decimal.

4. A bankrupt's liabilities are £3768 17 *s.* 6 *d.* What are his assets, if he can pay 13 *s.* 7½ *d.* in the pound?

5. Subtract $\frac{5}{1}\frac{}{2}$ dwt. from 2.6 ounces, and give the answer as the decimal of a pound Troy.

6. Divide 218.4 by 0.168.

7. Divide 12 by $6\frac{3}{4}\frac{}{0}$.

40.

1. Express 13 minutes 7½ seconds as the decimal of 1 hour.

2. Add 6, $1\frac{1}{4}$, $\frac{7}{1}\frac{}{6}$, and $\frac{1}{1}\frac{1}{2}$.

3. Find the cost of 11 miles 120 rods 165 feet of railway at $32,500 per mile.

4. Add 2.6 days and 0.85 of an hour, and give the answer in minutes.

5. In 156,704 square inches, how many square yards, etc.?

6. Divide 8.4605 by 0.248 to three places of decimals.

7. Subtract $6\frac{4}{5}$ from $8\frac{3}{7}$.

41.

1. In 57,625,318 square inches, how many acres, square rods, etc.?

2. A bankrupt's debts amount to £910 3*s*. 1½*d*., and his estate to £875. How much can he pay in the pound?

3. What is the circumference of a wheel which makes 514 revolutions in passing over 1 mile 467 yards 1 foot?

4. Find the value of $5\frac{3}{4} - 4\frac{1}{7} + \frac{5}{2\,8} - 1\frac{1}{2}$.

5. From $2\frac{1}{4} \div 3\frac{1}{3}$ take $\frac{1}{8} \times \frac{2}{5} \times \frac{5}{7} \times \frac{3}{8}$.

6. Divide 18.13 by 0.00037.

42.

1. A piece of cloth, when measured with a yard measure that is $\frac{3}{8}$ of an inch short, appears to be $10\frac{1}{2}$ yards long. What is its true length?

2. Divide 120,987.2 by 400.

3. Add $\frac{14}{17}$, $3\frac{1}{3}$, $1\frac{5}{51}$, and $\frac{6}{27}$.

4. Simplify $\dfrac{(4\frac{1}{2} + 7\frac{1}{2}) \div 3\frac{1}{2}}{\frac{1}{7} \times 2\frac{2}{7} \times 5\frac{1}{4}}$.

5. The weight of a cubic inch of water is 253.17 grains; that of a cubic inch of air 0.31 grains. Find to three places of decimals how many cubic inches of water are equal in weight to 1 cubic foot of air.

6. Find the price of 5 acres 72 square rods of land at $47.50 per acre.

43.

1. Reduce 42 rods 1 yard 8 inches to the fraction of a mile.
2. Find the value of 1.16875 acres.
3. Divide the product of 6.225 and 8.25 by 0.0025.
4. What fraction multiplied by $\frac{3}{5}$ will give $\frac{5}{6}$? what fraction divided by $\frac{3}{5}$ will give $\frac{5}{6}$? what fraction subtracted from $1\frac{3}{8}$ will give $\frac{7}{29}$?
5. Arrange in order of magnitude $\frac{21}{122}$, $\frac{20}{121}$, $\frac{22}{128}$.
6. A and B start at a distance of 64 miles from each other, A walks $3\frac{1}{2}$ miles an hour; B, $2\frac{1}{2}$. If they start at the same time, how many miles will they each walk before they meet?
7. A ship left England at noon, January 1, 1851. She reached a port in Australia at midnight (Greenwich time), April 23. If the length of the voyage was 18,225 miles, what was her average rate per hour?

44.

1. Subtract 17.2398 from 27.06.
2. Multiply 46.2375 by 0.0074.
3. Divide 92.3784 by 0.623 to three places of decimals.
4. Find the product of $\frac{9}{14}$, $\frac{5}{27}$, $9\frac{4}{5}$, $2\frac{2}{7}$.
5. Subtract 4.42 of an hour from 3.64 of a day.
6. Reduce 136,240 square feet to acres, etc.
7. Reduce 224,567 grains to pounds, ounces, etc., Apothecaries' weight.

45.

1. The imperial gallon contains 277.274 cubic inches. What is the size of a pint pot in cubic inches? What weight of water will it hold, if a cubic foot of water weighs 1000 ounces?

2. What number added to the sum of $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{6}$ will make 4?

3. A field of $3\frac{1}{2}$ acres is divided into 28 equal parts. What fraction of an acre is there in each part?

4. Find the sum of 17.01, 0.1303, 500.42101, 0.001, and 6.6.

5. Divide 6.2301533682 by 8.8964.

6. If 7 long tons 336 pounds of coal cost \$32.50, what will 1232 pounds cost?

46.

1. Find the wages of a man for 3 weeks 4 days 8 hours at \$8 per week, reckoning 6 days to a week and 10 hours to a day.

2. Reduce 30 rods 2 yards 1 foot to the fraction of 150 rods 4 yards 2 feet 1 inch.

3. If $\frac{5}{7}$ of an estate is worth \$870, what is the value of $\frac{2}{17}$ of it?

4. Express in the simplest form $3\frac{1}{2} + \frac{7}{8}$ of $10\frac{3}{4} + \frac{3\frac{1}{6}}{1\frac{3}{8}}$.

5. What number multiplied by $\frac{4}{5}$ will produce $90\frac{1}{3}$?

6. What number added to $1\frac{7}{10} + 3\frac{9}{16} + 2\frac{1}{20} + \frac{5}{24}$ will make the sum total 10?

7. Give in feet the value of 7.0125 miles.

47.

1. Given the fractions $\frac{8}{33}$, $\frac{39}{161}$, and $\frac{47}{194}$; express the difference of the first two as a fraction of the difference of the last two.

2. Reduce $\frac{1892}{1936}$ to its lowest terms.

3. Divide 16.9 by 0.0013, and also by 1.3.

4. Reduce $0.5\dot{3}$ and $0.009\dot{8}\dot{7}$ to equivalent common fractions.

5. Find the value of 0.3925 of 2 years, each year containing $365\frac{1}{4}$ days.

6. Reduce 6 yards 2 feet 7.5 inches to the decimal of a mile.

48.

1. What decimal of 1 day is 23 hours 15 minutes 6 seconds?

2. Find the average of $21\frac{2}{3}$, $73\frac{4}{5}$, 0, $3\frac{13}{200}$, 82, $17\frac{3}{20}$, $5\frac{1}{4}$, $9\frac{5}{12}$.

3. Add $\frac{7}{16}$ of £5, $\frac{2}{7}$ of £9 13 *s.* $2\frac{3}{4}$ *d.*, and $\frac{5}{12}$ of 2*s.* 6*d.*

4. A and B can do a piece of work in 7 days, B and C can do the work in 8 days, and all three together can do it in 5 days. What part of the whole work can each do in 1 day?

5. What will be the cost, at 18 cents a square yard, of painting the walls of a room 17 feet 3 inches long, 15 feet 5 inches wide, and 13 feet 6 inches high, allowing 54 square feet for windows, etc.?

6. Find what fraction the sum of $\frac{1}{24}$, $\frac{1}{56}$, $\frac{1}{21}$, and $\frac{1}{12}$ is of $2\frac{2}{7}$ of $1\frac{1}{6}$ of $\frac{8}{9}$.

49.

1. A person possessing $\frac{3}{14}$ of an estate sold $\frac{2}{7}$ of $\frac{5}{16}$ of his share for \$120.62½. What would $\frac{1}{5}$ of $\frac{3}{16}$ of the whole estate sell for at the same rate?

2. Express as a fraction of \$5 the difference between \$7$\frac{4}{5}$ and $\frac{4}{5}$ of \$7.

3. Subtract 2.63 dwts. from 12.13 ounces Troy, and express the answer in pennyweights.

4. In 76,128,976 inches how many miles, etc.?

5. Divide 78 by 361.059 to three places of decimals.

6. Find the value of $2.5 + \frac{1.5}{0.02} - 6.002$.

50.

1. Find the average of $12\frac{1}{2}\frac{2}{5}$, 21, $7\frac{3}{4}$, 0.034, 3.125, 0, 24.5, and $12\frac{7}{2}\frac{7}{0}$. Express the fractional part decimally.

2. Reduce to the simplest form $\frac{435.1 \times 0.0046}{0.125}$.

3. Divide the sum of 14.4 and 1.44 by their difference, and express the result as a common fraction.

4. A can build a wall in 3½ days, and B in 5½ days. In what time will A and B together do it?

5. A brick 9 inches long, 4½ inches broad, and 3 inches thick weighs 9 pounds nearly. What would a brick weigh if it were 12 inches long, 6 inches broad, and 4½ inches thick?

6. Subtract 73.4698 from 108.30125.

51.

1. Add $\frac{1}{6}$, $2\frac{1}{7}$, and $13\frac{8}{10}$; divide this sum by $13\frac{1}{14}$; and subtract the result from $5\frac{3}{70}$.
2. A cistern can be filled in 50 minutes by one pipe, and in 1 hour 5 minutes by another. In how many minutes will it be filled, if both are open together?
3. If a 4 per cent stock is at $82\frac{1}{8}$, what will be the cost of $1000 stock, and what sum will be gained by selling out at $86\frac{1}{4}$?
4. An army is besieging a town in which are 1000 men, with provisions for three months. How many must leave at once, in order that the rest may be able to subsist a year?
5. Divide 7.619 by 0.0019.
6. Arrange in order of magnitude $\frac{7}{15}$, $\frac{9}{17}$, $\frac{13}{25}$, $\frac{11}{21}$.

52.

1. A room is 20 feet 6 inches long, 15 feet 6 inches wide, and 16 feet high. It has two doors, each 8 feet by 3 feet 9 inches; it has one window 5 feet by 7 feet, and two windows, each 5 feet by 4 feet. What will it cost to paper the room with paper 1 yard wide, at 20 cents per yard?
2. Divide 0.101 by 0.5; by 0.05; by 50; and by 5000.
3. Reduce to a common fraction $0.01\dot{0}3\dot{4}$.
4. Divide $\frac{9}{11}$ of $\frac{19}{81}$ by $\frac{33}{1568}$ of $\frac{114}{121}$.
5. Find the square root of 488,601.
6. Find the simple interest of $1025 for 13 years at $4\frac{1}{2}$ per cent.

53.

1. If $\frac{3}{8}$ of a yard of cloth cost $\frac{2}{5}$ of a dollar, what will $\frac{5}{16}$ of a yard cost?
2. Find the greatest common measure of 2526 and 2947.
3. Subtract 0.002 from 11, and multiply 0.01 by 1.01.
4. Divide $2\frac{6}{7}$ of $1\frac{2}{5}$ by $3\frac{1}{3}$ of $\frac{3}{5}$ of $\frac{1}{4}$.
5. If 0.5 of £1 buys 0.4 of a gallon, how much may be bought for 6 *s.* 3 *d.*?
6. A steam engine and a horse start together. The engine does the first mile in 5 minutes, the horse in 4 minutes. After this mile the rate of the engine is 30 miles per hour, that of the horse 20 miles per hour. Which wins in a three-mile race, and by how much?

54.

1. Divide 1.44 by 1.2; by 12; by 0.012; and by 120.
2. Find the square root of 449.44.
3. What is the cost of carpeting a room 21 feet by 30 feet with carpet half a yard wide, running across the room, at 75 cents a yard?
4. Divide $1300 into three parts, in the ratio of 6, 4, 3.
5. If 12 men do a piece of work in 15 days of 12 hours each, how many days of 9 hours will 10 men take to do it?
6. Find the income produced by investing $4500 in 3 per cent bonds at 90; and that produced by investing $2850 in $3\frac{1}{2}$ per cent bonds at 95.

55.

1. Reduce 12 *s.* 6 *d.* to the decimal of a pound sterling.

2. Divide $\frac{1}{4}$ of $\frac{1}{5}$ of $4\frac{2}{7}$ of $2\frac{1}{8}$ by $\frac{1}{6}$ of $4\frac{1}{5}$ of $3\frac{3}{4}$ of $1\frac{1}{7}$.

3. Find the compound interest on $100 for two years at 10 per cent.

4. If 24 men do a piece of work in 14 days of 9 hours, how many men will do it in 12 days of 7 hours.

5. Find the least common multiple of 10, 14, 15, 21, 30, 42.

6. What sum invested in 3 per cent bonds at 92 will produce an income of $100 per annum?

7. The gross receipts of a railway company are $231,100. After deducting 35 per cent for working expenses, and paying 6 per cent interest on $2,500,000 bonds, what sum is left for dividing among the shareholders?

56.

1. Express as a decimal fraction the sum of $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, $\frac{9}{10}$, $\frac{11}{12}$.

2. Simplify $\dfrac{1}{2+\dfrac{3}{4+\frac{5}{6}}}$; and $\dfrac{\frac{2}{3}\times\frac{3}{8}\div 2}{\frac{1}{6}\left(\frac{4}{5}-\frac{1}{16}\right)}$.

3. Divide 36.33 by 210; 35 by 0.05; 0.002 by 200.

4. Find the square root of 22.1841.

5. If 3 pounds of tea at $1.56 per pound, 5 pounds at $1.20, and 7 pounds at $.60 are mixed, at what price per pound must the mixture be sold to gain $2\frac{1}{2}$ per cent?

6. Find the interest of $535 for 9 months at $4\frac{1}{2}$ per cent.

57.

1. Find the greatest common measure of 124,321 and 197,451.

2. Reduce 0.075 of a pound sterling to the common fraction of 4*s.* 6*d.*; and 2 square rods 9 square yards 4 square feet 72 square inches to the common fraction of 1 acre 60 square yards.

3. A man buys eggs at 11 cents per dozen, and sells them at 2 cents apiece. What does he gain per cent?

4. What sum, if put out at $3\frac{1}{2}$ per cent for 6 years, will produce $\$28.87\frac{1}{2}$, simple interest?

5. Divide 1.69 by 0.13; 12.1 by 0.011; 0.001 by 0.01.

6. Find the square root of 4.1209.

58.

1. Find the simple interest on \$387.50 for 5 years 3 months at $3\frac{1}{2}$ per cent.

2. Find the least common multiple of 3, 5, 7, 9, 15, 63.

3. Divide $1-(\frac{1}{2}+\frac{1}{3}+\frac{1}{24})$ by $1-\frac{1}{2}$ of $\frac{1}{3}$ of $\frac{1}{24}$.

4. Multiply 0.000725 by 31.25; and divide the product successively by 6.25, 625, and 0.0625.

5. At what price per hundredweight must goods be *sold*, which were bought at \$5 per ton, in order to gain 6 per cent?

6. A manufacturer makes a profit of 20 per cent, wholesale dealer 25 per cent, shopkeeper 40 per cent. What is the first cost of an article bought at a shop for \$4.20?

59.

1. Divide \$154 among 4 persons in the proportion of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.
2. In how many days of 12 hours will 72 men do a piece of work which 60 men can do in 30 days of 9 hours?
3. Find the interest on \$354.27 for 3 years 2 months 12 days at $2\frac{1}{4}$ per cent.
4. \$4500 is divided among A, B, C, and D. A receives $\frac{1}{2}$ of the money, B and C each $\frac{2}{7}$ of the remainder. How much is left for D?
5. Express as common fractions 0.001375; $0.\dot{0}\dot{3}$; $7.19\dot{3}\dot{1}\dot{8}$.
6. A can walk 10 miles in $2\frac{1}{4}$ hours, and B can walk 11 miles in $2\frac{1}{2}$ hours. They start to walk a match of 55 miles. Which will win, and by how much time?

60.

1. The profit made by selling beer at 1 *d.* per pint above cost is 50 per cent. What is the gain per cent by selling it at 6 *d.* per gallon above cost?
2. Find the compound interest on \$66.67 for 2 years at 9 per cent.
3. How much money must be invested in 3 per cent bonds at 92 to secure an annual income of \$150?
4. Find the L.C.M. of 12, 84, 120, 132, 156.
5. Reduce $\frac{1305}{6960}$ to lowest terms.
6. A piece of work can be done in 50 days by 35 men. After 12 days 16 men strike. How soon will the rest finish the work?

61.

1. Find the greatest common measure of 5522 and 6006.

2. Divide $\frac{1}{12} - \frac{1}{15}$ by $3\frac{1}{7\frac{1}{5}} - 2\frac{2\frac{1}{2}}{2\frac{1}{5}}$.

3. Express as common fractions 0.06125 and $0.12\dot{3}\dot{7}$.

4. If a room is 27 feet 5 inches long, 14 feet 7 inches wide, 12 feet 10 inches high, how much paper $\frac{7}{8}$ of a yard wide is required to cover the walls?

5. What is the amount at simple interest of $1275 in 5 years 8 months at $3\frac{4}{5}$ per cent?

6. If I buy sugar at $7 per cwt., at what rate per pound must I retail it to gain $7\frac{1}{7}$ per cent?

62.

1. If 8 men can reap 40 acres of wheat in 7 days, how many acres will 24 men reap in 28 days?

2. Find the square root of 2,900,209.

3. How many cubic feet of air in a room 10 feet long, 8 feet 6 inches broad, and 6 feet 6 inches high?

4. A $4\frac{1}{4}$ per cent stock can be purchased at 91. What per cent interest will this investment yield?

5. When the Centigrade thermometer marks 25 degrees, what will Fahrenheit's thermometer mark?

6. Find the greatest common measure of 210; 258; 903.

63.

1. Simplify $\dfrac{1}{3+\dfrac{3}{4\frac{1}{2}}}$ and $\dfrac{2\frac{1}{4}-1\frac{3}{5}}{8.5+1.9}$.

2. Express as decimals $\frac{1}{2\frac{1}{5}}$, $\frac{3}{1\frac{3}{7}}$, and $\dfrac{15s.\ 9\frac{3}{4}d.}{£1}$.

3. How many miles will a ploughman walk, in ploughing an acre of ground, if each furrow is a foot in breadth?

4. A room is $12\frac{1}{2}$ feet by 10 feet, and 7 feet high. How many yards of paper 2 feet 6 inches wide will it take to paper the room, if the waste is ten per cent?

5. A plank is 3 inches thick, 18 inches wide, and 30 feet long. How many board feet does it contain?

6. Eggs are sold at the rate of 5 for 4 cents. At what price were they bought if the profit was 20 per cent?

64.

1. Find the square root of 0.00027 to four places of decimals.

2. If I sell \$2500 3 per cent stock at 95, and invest the proceeds in $4\frac{1}{2}$ per cent stock at par, what difference does it make in my income?

3. What is the cost of papering a room 16 feet long, 12 feet wide, $10\frac{1}{2}$ feet high, with paper 21 inches wide at 7 cents per yard, if the waste is $12\frac{1}{2}$ per cent?

4. Express $\frac{7}{256}$ as a decimal; and $0.\dot{1}23\dot{6}$ as a common fraction.

5. Divide 22.4615 by 0.167; and 0.004095 by 0.273.

6. Find the least common multiple of 3, 8, 15, 21, 18.

65.

1. A owns $\frac{1}{3}$ of a vessel, B $\frac{1}{4}$, and C $\frac{1}{5}$, and the rest belongs to the master. What is the master's share?
2. If two acres will maintain 3 horses for 4 days, how long will 6 acres maintain 6 horses?
3. Divide 9.3828 by 1117; by 11.17; by 0.01117.
4. What is the difference between the simple and compound interest on $550 for 3 years at 5 per cent?
5. A merchant sold goods for $750 more than he paid for them, and cleared 15 per cent. What did he pay for them?
6. Two boats row a race of 1 mile 720 yards. One rows 31 strokes a minute, and clears 30 feet each stroke; the other rows 33 strokes, and clears 28 feet. How many yards ahead will the winning boat be when it passes the winning post?

66.

1. What is the price of a Turkey carpet 20 feet 6 inches long by 12 feet 9 inches wide, at $5.04 a square yard?
2. If I invest $3570 in 7 per cent stock at 2 premium, what income do I derive from it?
3. A grocer bought 40 pounds of tea at 60 cents, and 90 pounds of coffee at 42 cents a pound. He sold the tea at 96 cents and the coffee at 36 cents a pound. What did he gain or lose?
4. Find the least common multiple of 34, 51, 85, 120, 170.
5. Simplify $\frac{12.4 + 0.064 - 0.066}{0.002}$.
6. Add $\frac{1}{4}$ of $\frac{3}{5}$ of 5*s.* 4*d.*, $\frac{2}{3}$ of $\frac{5}{7}$ of 6*s.*, $\frac{3}{7}$ of $\frac{2}{5}$ of 2*s.*

67.

1. Find the cost of papering a room 21 feet long, $16\frac{1}{2}$ feet wide, $10\frac{1}{4}$ feet high, at 15 cents per square yard.

2. A can run 10 yards to B's 9. How many yards start must A give B in a mile to make an even race?

3. Simplify $\dfrac{1-\frac{1}{5}\left(\frac{1}{2}+\frac{1}{7}\right)}{1-\dfrac{1}{2-\frac{1}{4}}}$.

4. If I sell out \$10,000 of $3\frac{1}{2}$ per cent stock at $94\frac{1}{2}$, and buy with the proceeds 6 per cent stock at 105, what will be the alteration in my income?

5. Find the true discount on \$1025.62$\frac{1}{2}$ for 6 months at $5\frac{1}{8}$ per cent per annum.

6. Reduce to its lowest terms $\frac{359775}{446121}$.

68.

1. Find the L.C.M. of 2, 3, 4, 5, 8, 12, 72, 84.

2. Simplify $\dfrac{2\frac{13}{16}\times\frac{1}{3}}{\frac{3}{5}\text{ of }\frac{5}{18}\div 5\frac{1}{6}}\div\frac{1}{5}\text{ of }1\frac{15}{16}$.

3. Find the cost of paving a passage 15 yards 2 feet 6 inches long, and 3 yards 6 inches wide, with tiles costing \$3.60 per square yard.

4. Add together $53\frac{1}{2}$, 36.875, $4\frac{5}{8}$, $\frac{2}{3}$ of $7\frac{1}{2}$, and divide the result by 0.01.

5. If 6 men can dig 5 acres in 8 days of 10 hours, in how many days of 12 hours can 4 men dig 6 acres?

6. At what rate of interest will \$2560 amount to \$3328 in 5 years?

69.

1. If I sell out \$1000 from 3 per cent stock at 88, and buy 5 per cent stock at 110, what alteration do I make in my income?

2. If a man buys 560 tons of coal at 14*s.* 8*d.* per ton, and sells it at 11*d.* per cwt., what is his gain per cent?

3. Divide 42.5 by 0.017; and find the value of 0.625 of 3 pounds Avoirdupois.

4. Simplify $3-(\frac{1}{2}+\frac{1}{3})-(\frac{1}{5}+\frac{1}{6})$.

5. Find the square root of 1.00060009.

6. The gross yearly rental of an estate is \$2100; taxes and repairs amount to 25 per cent of the rental. The owner sells the estate for 21 times the gross yearly rental, and invests the proceeds in 3½ per cent stock at 98. What does he gain or lose in his net income?

70.

1. If \$1350 at simple interest amount to \$1570.50 in 1 year 8 months, find the rate per cent.

2. If by selling wine at \$3 a gallon I lose 6 per cent, at what price must I sell it to gain 17½ per cent?

3. Find the compound interest on \$750 for 5 years at 2½ per cent.

4. Reduce 347,894,178 square inches to acres, etc.

5. If \$850 amounts to \$913.75 at 2½ per cent, find the time.

6. A room is 10 feet high, 5½ yards long, and 3 yards wide. It contains a door 8 feet by 4 feet, two windows each 5 feet by 4 feet, and a fireplace 6 feet by 4 feet 6 inches. How many square yards on its walls require to be painted?

71.

1. The distance between the posts of a railway telegraph is 60 yards. Find the rate of a train which passes 11 posts in 50 seconds.

2. Find the income from an investment of $5308.33 in 3 per cent bonds at 91.

3. A invests $1200, B $2400, in business. The net profit at the end of the year is $720. How much should A and B each receive, and what is the rate of interest upon the investment?

4. Find the least common multiple of 5, 7, 16, 28, 48, 21.

5. If $\frac{1}{8}$ of a ship be worth $292.25, what part of her will be worth $1002?

6. If 10 men can reap 20 acres in 4 days, how many men can reap 70 acres in 10 days?

72.

1. What sum of money will amount to $276.25 in 1 year and 3 months at 5 per cent simple interest?

2. When 3 per cent bonds are at 75, what sum must be invested to produce an annual income of $120?

3. Find the present worth of $1836, due 4 years hence, at 5 per cent simple interest.

4. What is the rent of a field containing 112 acres 109.5 square rods at $2.64 an acre?

5. Divide 1368.2394 by 2400.21, and by 0.00240021.

6. Simplify $\frac{1\frac{7}{9} \text{ of } \frac{27}{64}}{\frac{11}{12} \text{ of } 9\frac{9}{11}} \div \frac{4\frac{4}{7} \text{ of } \frac{21}{160}}{2\frac{5}{6} \text{ of } \frac{15}{34}}$.

73.

1. Find the value of £2 + $\frac{1}{5}$ of £140 10*s.* 6*d.* + $\frac{3}{5}$ of £1 1*s.*

2. Find the greatest common measure of 1288, 1736, 104.

3. If 120 men build a house 60 feet high in 15 days, how many will build a house 55 feet high in 10 days?

4. Find the difference between the simple and compound interest on $955 at 6 per cent for 4 years.

5. A garrison of 1000 men have provisions for 30 days. At the end of 10 days a reinforcement arrives, and then the provisions last only 5 days. What is the number of the reinforcement?

6. Simplify $\frac{(2+\frac{1}{5})\div(3+\frac{1}{7})}{(\frac{1}{2}-\frac{1}{3})\times(4-3\frac{3}{7})}$.

74.

1. Express $0.46\dot{6}$ as a common fraction.

2. A sum of money was borrowed at 5 per cent simple interest. In 7 years it amounted to $810. What was the sum borrowed?

3. If 100 men in 6 days of 10 hours can dig a trench 200 yards long, 3 yards wide, and 2 yards deep, in how many days of 8 hours can 180 men dig a trench 360 yards long, 4 yards wide, and 3 yards deep?

4. Find the cube root of 42,508,549.

5. How many rods of fencing are required to enclose a square park containing 832 acres 105 square rods?

6. Which is the better investment, 4 per cent stock at 120, or 2½ per cent stock at 75?

75.

1. What is the length of the edge of a cubical cistern which contains as much as a rectangular one whose edges are 154 feet 11 inches, 70 feet 7 inches, and 53 feet 1 inch?

2. For what must I sell a horse that cost me $75.50 so as to gain 5½ per cent?

3. By selling 12 pounds of tea for $7.56, I gain 5 per cent. What do I gain or lose per cent by selling 50 pounds of the same tea for $31?

4. Find the amount of $4250 for 2 years 6 months at 5 per cent compound interest.

5. Reduce $\frac{8}{3}\frac{5}{3}\frac{6}{6}$ and $\frac{1}{3}\frac{8}{0}\frac{5}{0}\frac{2}{8}$ to their lowest terms.

6. How can you tell without dividing whether a number is exactly divisible by 11?

76.

1. Find the amount of $7234.25 at 4½ per cent simple interest, in 22 years 2 months 20 days.

2. If 20 men build a wall 800 feet long, 10 feet high, and 18 inches thick in 14 days of 8 hours, how thick a wall will 15 men build 900 feet long and 15 feet high in 21 days of 9 hours?

3. Subtract 0.992748 from 1.

4. Find the cost of 3 acres 145 square rods of land, at $120 an acre.

5. What is the price of a silver bowl weighing 5 pounds 9 ounces 8 dwts., at $1.40 per ounce?

6. Add together $\frac{7}{16}$, $\frac{2}{3}$, $\frac{5}{48}$, $3\frac{19}{24}$.

77.

1. How many tiles, each 7 inches square, will be required to cover a floor 19 feet 3 inches by 13 feet 5 inches?

2. Extract the cube root of 0.145531576.

3. If a tradesman, by selling an article at $1.98, loses 17½ per cent, for what should he have sold it to gain 40 per cent?

4. What is the income of a man whose income tax at 4 *d.* in the pound amounts to 23 guineas?

5. If 2 horses can plough 7 acres of ground in a day, how many horses will plough 161 acres in 11½ days?

6. In 1,250,784 seconds, how many weeks, days, etc.?

78.

1. Divide 2054.95 by 0.0563.

2. A merchant sells tea to a tradesman at a profit of 60 per cent; but the tradesman, failing, pays only 12½ cents on the dollar. How much per cent does the merchant lose by the sale?

3. When a 3½ per cent stock is at 93, find what price a 4½ stock must bear that an investment may be made with equal advantage in either stock.

4. Find the cube root of 134,217,728.

5. Find the product of $10\frac{1}{8}$, $\frac{6}{15}$, $\frac{24}{27}$, and $1\frac{1}{3}$.

6. If 14 men can mow 168 acres in 12 days of 8½ hours, how many acres can be mowed by 20 men in 11 days of 7⅘ hours?

79.

1. Between the years 1841 and 1851, the population of England increased $14\frac{1}{8}$ per cent. In 1851, the population was 21,121,290. What was it in 1841?

2. A merchant has teas worth \$1.08 and 84 cents per pound respectively, which he mixes in the ratio of 3 pounds of the first kind to 2 of the second kind, and sells the mixture at \$1.04 per pound. What does he gain or lose per cent?

3. A person invests \$5460 in 3 per cent stock at 91; he sells out \$2000 stock when it has risen to $93\frac{1}{2}$, and the remainder when it has fallen to 85; he invests the proceeds in $4\frac{1}{2}$ per cent stock at 102. What is the alteration in his income?

4. Extract the cube root of 5.78 to three places of decimals.

80.

1. If 48 pioneers in 5 days of $12\frac{1}{2}$ hours can dig a trench $139\frac{3}{4}$ yards long, $4\frac{1}{2}$ yards wide, and $2\frac{1}{2}$ yards deep, how many hours a day must 270 pioneers work for 42 days, in order to dig a trench $4910\frac{1}{16}$ yards long, $4\frac{7}{8}$ yards wide, and $3\frac{1}{5}$ yards deep?

2. If a man rows 10 miles in $2\frac{1}{2}$ hours against a stream, the rate of which is 3 miles an hour, how long will he be rowing 5 miles with the stream?

3. Find the price of 5 acres 127 square rods and 88 square yards at $\$161\frac{1}{3}$ per acre.

4. If a person selling sugar at $9\frac{1}{2}$ cents per pound loses 10 per cent, what did he give per hundredweight?

81.

1. A square contains 40,092.0529 square feet. Find the length of one of its sides.

2. Simplify $\frac{(0.075 \times 0.075) - (0.005 \times 0.005)}{0.75 - 0.05}$.

3. A person invested $4706 in 3 per cent stock at 90½. A year afterwards, when the 3 per cent stock had fallen to 89, he sold out one-half of his stock and reinvested it in 5 per cent foreign bonds at 52. What change did the reinvestment make in his income?

4. If 50 men dig a trench 120 yards long, 5 feet broad, 10 feet deep in 3 days of 10 hours, in how many hours will they dig a trench 175 yards long, 4 feet broad, and 8 feet deep?

5. Simplify $\frac{3\frac{1}{3} + 4\frac{1}{4} + 5\frac{1}{5}}{1\frac{2}{3} + 2\frac{1}{3} + 2\frac{3}{5}} \times \frac{3\frac{4}{7} + 4\frac{1}{16} + 4\frac{5}{9}}{7\frac{1}{7} + 8\frac{1}{8} + 9\frac{1}{9}}$.

82.

1. Find the least common multiple of 14, 36, 84, 108, 144.

2. Simplify $\frac{9\frac{7}{8} - 8\frac{6}{7} + 6\frac{5}{6} - 5\frac{4}{5}}{8\frac{9}{10} - 7\frac{13}{15} + 6\frac{7}{8} - 5\frac{6}{7}}$.

3. If with a capital of $500 a tradesman gains $50 in 7 months, in what time will he gain $60.50 with a capital of $385?

4. A certain 4½ per cent stock is at a discount of 23. What income should I get from $385 invested in it?

5. Find the cost of papering the walls of a room 10 feet 8 inches wide, 19 feet 4 inches long, and 9½ feet high, with paper 2 feet wide at 5 cents a yard, allowing 10 yards of the paper for waste.

83.

1. If 1 inch of rain on 4840 square yards gives 18,200 gallons of water, how many gallons will 0.875 of an inch on a square mile give?

2. If the amount of property liable to income tax be 525 million pounds sterling, how many pence in the pound must the tax be to produce $17\frac{1}{2}$ million pounds?

3. The circumferences of two of the wheels of an engine are $24\frac{3}{4}$ feet and $16\frac{1}{2}$ feet respectively. How many more times will one turn round than the other in $4\frac{1}{2}$ miles?

4. If the shadow of an upright pole 9 feet high be $7\frac{1}{2}$ feet, what will be the height of a church spire which casts a shadow $247\frac{1}{2}$ feet long?

5. Simplify $\dfrac{\frac{4}{7} \text{ of } 5\frac{3}{5} + \frac{1}{4} \text{ of } 3\frac{1}{3}}{2\frac{1}{5} + 1\frac{1}{12}} \div \dfrac{10\frac{1}{8} - 8\frac{3}{4}}{6\frac{3}{4} - 2\frac{1}{2}}$.

84.

1. Find the value of 3.75 of half-a-crown ($2\frac{1}{2}s.$) + 4.4 of a guinea ($21s.$) + 1.024 of £22.

2. Find the length in yards of the side of a square enclosure which contains 4 acres 144 square rods.

3. A plot of ground 50 yards long and 40 yards wide is to be covered with sods $1\frac{1}{2}$ feet long and 6 inches broad. If the sods cost 75 cents per hundred, what will be the expense for turf alone?

4. Find the present worth of $122.80 due 7 months hence, at 4 per cent.

5. In a town where the annual death rate is $2\frac{1}{2}$ per cent, the average number of deaths a week (52 weeks to the year) is 228. What is the population of the town?

85.

1. A person transfers $3000 from a 4 per cent stock at 90 to a 3 per cent stock at 72. How much 3 per cent stock can he purchase, and what will be the difference in his income?

2. A cistern 5 feet deep, 16 feet long, 4 feet 6 inches wide, is filled by one pipe in 45 minutes. In what time will a cistern 6 feet deep, 20 feet long, 5 feet wide, be filled by 3 similar pipes?

3. Multiply 0.416 by 0.025, divide the product by 3.25, and reduce the result to a common fraction.

4. A clothier gains 25 per cent by selling cloth at $5 per yard; but a bale of 80 yards being damaged, he has to reduce the price 10 per cent. What is now his profit on the bale, and his gain per cent?

5. Add $12\frac{1}{12}$, $13\frac{5}{16}$, $17\frac{2}{3}$, and $\frac{19}{144}$.

86.

1. Simplify $\frac{5\frac{1}{4}}{4\frac{1}{6}} \times \frac{1\frac{4}{11}}{2\frac{5}{21}} \div \frac{5\frac{2}{5}}{6\frac{5}{7}}$.

2. Find the difference between $\frac{3}{11}$ of 200 rods and $\frac{5}{16}$ of $\frac{1}{4}$ of a mile.

3. What fraction of 560 pounds is equal to $0.15\dot{9}\dot{0}$ of a long ton?

4. $13,000 of $3\frac{1}{2}$ per cent stock is sold at 98. How much money must be added to the sum realized in order to secure an equal income in 3 per cent stock at 87?

5. An army of 120,000 men lost 15 per cent by desertion to the enemy. What increase per cent did the enemy gain, their number previously being 64,000?

87.

1. In 1870 three towns had populations of 17,650, 19,600, and 18,760 respectively. In 1880, the population of the first had decreased 18 per cent, that of the second had increased 21 per cent, while the population of the three towns had increased by 4691. Find the change per cent in the population of the third town.

2. What fraction of $\sqrt{5\frac{4}{9}}$ is $\sqrt{0.000225}$?

3. Simplify $\dfrac{5\frac{1}{2} - 0.042 - 2.4 + 7\frac{5}{6}}{16\frac{2}{15} \div 60\frac{1}{2}}$.

4. Find the square root of 1,079,521 and 0.1079521.

5. What is the gain by investing $\$1950$ at $97\frac{3}{8}$ and selling out at 104, the brokerage on each transaction being $\frac{1}{8}$ per cent?

88.

1. Find the value of $\dfrac{3}{\sqrt{19} - 4}$ correct to four places of of decimals.

2. Find the simple interest on $\$281.60$ at $3\frac{1}{2}$ per cent for 4 years and 2 months.

3. By selling a carriage for $\$73.15$, I should lose 5 per cent. At what price must I sell it to gain 15 per cent?

4. Which is the better investment, 3 per cent stock at $64\frac{1}{4}$, or 5 per cent stock at $102\frac{3}{4}$?

5. A person has a certain capital, half of which is invested in 3 per cent stock at 90, and the other half in 5 per cent at 110. His total income is $\$6883.50$. What is his capital?

89.

1. At what rate per cent will a given sum of money double itself at simple interest in 30 years?

2. A grocer has tea, which he must sell at 84 cents per pound to gain 40 per cent. If he mixes it with tea which cost him 54 cents per pound, in the ratio of 7 of the better kind to 3 of the poorer, and sells the mixture in 10-pound packages at $7.76, how much does he gain per cent?

3. How many times is 224 pounds 2 ounces contained in 6 long tons 8 cwt. 8 pounds?

4. Find $\frac{1}{8}$ of 8 miles 145 rods 3 yards 1 foot 6 inches.

5. The sides of two squares contain 77 yards 1 foot 9 inches, and 7 yards 2 feet 4 inches, respectively. Find the side of a square whose area is equal to the sum of the areas of the two squares.

90.

1. If a railway journey of 177 miles 120 rods takes 3 hours 56½ minutes, what is the rate per hour?

2. Multiply 209 acres 145 square rods 3 square yards by 13.

3. Two wines worth $8 and $6 per gallon respectively are mixed together. If the mixture is worth $6.87½ a gallon, in what ratio are they mixed?

4. A tradesman pretends to charge 10 per cent above the wholesale price, but he has adulterated his goods with 50 per cent of a poorer kind, which costs only $\frac{2}{3}$ of the price. What is his real rate of profit?

5. Express as decimals $\frac{4}{8\,8}$, $\frac{6}{8\,8}$, and $\frac{8}{8\,8}$.

91.

1. If the 2-penny loaf weighs 15 ounces when wheat is at 8 shillings, how is wheat selling when the 3½-penny loaf weighs 2 pounds?
2. Find exactly the cube root of $1{,}277{,}289\frac{217}{216}$.
3. Reduce $\frac{68227}{289997}$ to its lowest terms.
4. What fraction is 1 week 7 hours 12 minutes of the time from Jan. 1, 1800, to Feb. 27, 1864, both days inclusive?
5. Find the circulating decimal equivalent to $\frac{1}{1001}$.
6. At what rate per cent will a person receive interest who invests his capital in 3 per cent stock at 91?

92.

1. At what price must a person buy 3 per cent stock to receive interest at the rate of 3¼ per cent?
2. If a vessel sails 500 miles in 2 days 18½ hours, how far will she sail between May 20 at noon, and 8 o'clock on the morning of July 10?
3. A person buys coffee at $24 per cwt., and chicory at $10 per cwt., and mixes them in the ratio of 2 of chicory to 5 of coffee. He retails the mixture at 30 cents per pound. What is his gain per cent?
4. A and B enter into partnership. A puts in $2100, B $1500. Four months after, C enters the partnership with $2700. At the end of the year the profit is 10 per cent on the whole capital. What share of the profit belongs to each?
5. If oranges are bought at the rate of 20 for 25 cents, how many should be sold for $12 to gain 40 per cent on the cost?

93.

1. Find the ratio of the rates for freight on two railroads, one of which charges $\$5.62\frac{1}{2}$ for carrying 4200 pounds 44 miles, and the other, $\$7.86\frac{1}{2}$ for carrying 5376 pounds $52\frac{1}{2}$ miles.

2. If the discount on $\$127.925$ for 20 days be $\$0.175$, find the rate per cent.

3. A gold wreath, weighing 3 pounds 7 ounces 12 dwt., cost $\$1275$. If it is made of gold worth $\$19.37\frac{1}{2}$ per ounce, what is charged for the manufacture?

4. Divide 24.109932 by 301.28.

5. Find the value of 0.90625 of a cubic yard.

6. Simplify $3\frac{1}{7} + 3\frac{3}{10} + 2\frac{3}{11} + 2\frac{5}{22} + \frac{2}{35}$.

94.

1. Reduce 18 days 5 hours 40 minutes 20 seconds to the fraction of 31 days 21 hours 30 minutes 10 seconds.

2. Show that the greatest common measure of two numbers is the least common multiple of all their common measures.

3. A bought 63 sheep, and sold $\frac{4}{9}$ of them at a profit of 15 per cent, $\frac{1}{7}$ at a profit of 50 per cent, and the rest at a loss of 25 per cent. What did he pay for the sheep, if his gain was $\$19.25$ on the whole?

4. Find the simple interest on $\$500$ for 8 years 3 months at $1\frac{1}{2}$ per cent.

5. Find the cost of 369 miles 120 rods 22 yards of telegraph wire at $\$73.33\frac{1}{3}$ per mile.

95.

1. What sum will amount to $5431.80 in 6 years at 4½ per cent simple interest?

2. Reduce 11 rods 4 yards 4.5 inches to the decimal of a mile.

3. Find the greatest common measure of 14,938, 23,474, 32,010.

4. Find the number of seconds from the beginning of the year 1883 to Dec. 17, 9 A.M., and express the result in words.

5. Extract the cube root of 5 to four places of decimals.

96.

1. Supposing the area of a circle to be 3$\frac{1}{7}$ times the square of the radius, find the weight of a circular disc of cast iron 7 feet in diameter, and 1$\frac{1}{8}$ inches thick, knowing that a plate 1 foot square and 1 inch thick weighs 37$\frac{1}{2}$ pounds.

2. If $\frac{1}{5}$ of a sheep is worth $\$\frac{2}{3}$, and $\frac{3}{7}$ of a sheep is worth $\frac{1}{14}$ of an ox, what is the value of 100 oxen?

3. Find the entire surface of a cube, the volume of which is 14 cubic feet 705.088 cubic inches.

4. Find the cost of a draft for $400, payable 60 days after sight, exchange being $\frac{1}{4}$ per cent discount, and interest 7 per cent.

5. A man bought a horse for $125 and sold him for $100. What per cent of the cost of the horse did he lose?

6. Multiply 4 acres 67 square rods 19 square yards 4 square feet 72 square inches by 27.

97.

1. In what time will the simple interest on $375, at 4 per cent, amount to $91.25?

2. Divide the number 702 into 3 parts, proportional to $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.

3. Divide 75 miles, 79 rods, 3 yards by 75.

4. How many bricks, each 9 inches by $4\frac{1}{2}$ inches by 3 inches are there in a pile 36 feet long, 9 feet wide, and 12 feet high?

5. Find the face of a draft, payable 60 days after sight, that can be bought for $1250, when exchange is at $\frac{1}{4}$ per cent premium, and interest 7 per cent.

6. Find the square root of 0.9 to four places of decimals.

98.

1. After paying $\frac{1}{3}$ of my money to one person, $\frac{1}{2}$ to another, and $\frac{1}{4\frac{1}{8}}$ to a third, I had 7 cents remaining. How much had I at first?

2. A person walks at the rate of $3\frac{1}{2}$ miles an hour. Three hours after he has set out on a journey, he is followed by another person, walking at the rate of 5 miles an hour. In what time will he be overtaken?

3. A grocer mixes 72 pounds of tea at 69 cents a pound with 90 pounds of tea at 60 cents a pound. At what price per pound must he sell the mixture so as to gain 10 cents a pound?

4. Extract the cube root of $\frac{5}{8}$ to four places of decimals.

5. At what rate per cent will $3000 produce $250 interest in 1 year 2 months and 24 days?

99.

1. Find the interest of $1721.84 from April 1 to Nov. 12 at $4\frac{1}{2}$ per cent.

2. At what rate per cent will $1025.20 produce $25.72 interest in 4 months 9 days?

3. Find the principal that will produce $1339.28 in 2 years 7 months 24 days at 6 per cent compound interest.

4. Find the time in which $793.875 will amount to $805.84 at $5\frac{1}{2}$ per cent.

5. Find the proceeds of the following note:

DETROIT, Feb. 2, 1881.

Four months after date I promise to pay to the order of John Horn four thousand five hundred fifty and $\frac{86}{100}$ dollars, value received.

JAMES THORN.

Discounted at a bank at $5\frac{1}{2}$ per cent, Feb. 16.

100.

1. A bankrupt has goods worth $975, and, had they realized their full value, his creditors would have received $81\frac{1}{4}$ per cent of their claims; but $\frac{3}{5}$ of the goods were sold at $17\frac{1}{2}$ per cent, and the remainder at $23\frac{3}{4}$ per cent below their value. How many cents on the dollar did the bankrupt pay?

2. Find the value of 157 miles 144 rods of telegraph wire at $57.50 per mile.

3. Reduce $\frac{595}{1071}$, $\frac{1547}{5712}$ to their lowest terms, and express their difference as a decimal.

4. Extract the cube root of 1250.6894.

5. Extract to six places of decimals the square root of 19.

101.

1. If a person steps 80^{cm} at each step, how many steps will he take in walking round a square field *containing* $18^{ha}\ 625^{qm}$?

2. How many cords of wood can be piled in a woodshed 128 feet long, 42 feet wide, 12 feet high, allowing for a driveway 10 feet wide, running from one end of the building to the other?

3. The true discount on a bill of $470.89, due 4 years hence, is $85.62; find the rate per cent.

4. If the retail price of a book is $6, and 25 are sold for $102, what rate per cent of discount is allowed?

5. A merchant insures a cargo whose value is $4500 at 5 per cent. For what sum should he insure so as to cover both the loss of the cargo and the premium?

6. A man sent $500 to his agent in Chicago, with which to buy flour. The agent bought flour at $5 a barrel, charging $2\frac{1}{2}$ per cent commission for buying. How many barrels of flour can he buy, reserving for himself his commission, and how much money will be left over?

102.

1. Find the sum of 1871^{ccm}, 541^{l}, 4.51^{hl}, and give the answer in liters.

2. What is the commission on goods worth $767.73 at $7\frac{1}{2}$ per cent?

3. Required the equated time for the payment of $700 due in 6 months, $800 due in 9 months, and $600 due in 10 months.

4. When 3 per cent stock is at $91\frac{3}{4}$, find how much can be bought for $540, allowing $\frac{1}{8}$ per cent commission upon the stock bought.

5. Find the cube root of 0.75 to four places of decimals.

6. If 2 men can reap $2\frac{1}{2}$ acres in $2\frac{3}{4}$ days, how long will it take 11 men to reap 15 acres?

103.

1. If it takes 25 minutes for a man who reads 2 pages in 3 minutes to read a certain document, how long will it take a man who reads a page a minute to read a document 3 times as long?

2. A man sells $7500 of 6 per cent railway stock at 120, and invests half the proceeds in 3 per cent stock at 93, and the other half in 5½ per cent stock at 90. Find the alteration in his income.

3. A piece of land 2449^{m} square is sold for $35 a hektar. How much does the land bring?

4. If cloth is sold for $3.75 a yard at a loss of 10 per cent, what should be the selling price a yard to gain 18 per cent?

5. Find the cube root of 0.3 to four places of decimals.

104.

1. A company whose capital is $2,500,000 pays an annual dividend of 6½ per cent, besides paying a tax of 1½ per cent on its whole capital. Find the total annual receipts, the expenses being 60 per cent of the gross receipts.

2. Bought 4 lots of wool at $652.50 each, and sold the whole at 20 per cent profit. What was the selling price per lot?

3. If the increase in the number of male and female criminals is 1⅘ per cent, while the decrease in the number of males alone is 4⅘ per cent, and the increase in the number of females is 9⅘ per cent, find the ratio of male criminals to female criminals.

4. Find the cost of a carpet 75^{cm} wide, at $4.25 a meter, for a room 5.25^{m} long, and 4.75^{m} wide, strips running across the room, if there is a total waste of 3^{m} in matching the pattern.

5. Extract the square root of 0.2 to five decimal places.

105.

1. An army lost 18 per cent of its strength by sickness and desertion, and then lost 14 per cent of the remainder in battle. The number left was 84,624. Of how many did the army originally consist?

2. If 6 iron bars 4 feet long, 3 inches broad, and 2 inches thick weigh 288 pounds, how much will 15 weigh, each $6\frac{1}{2}$ feet long, 4 inches broad, and 3 inches thick?

3. Find the cost of plastering a room 13^{m} long, 12^{m} wide, and 7^{m} high, at 30 cents a square meter, if 115^{qm} are allowed for base-board, doors, etc.

4. Find the cube root of 25 to three places of decimals.

5. In 1841, the population of Great Britain was 21,476,000, and that of Ireland 7,310,000. In 1851, the population of Great Britain had increased 8.45 per cent, and that of Ireland had decreased 12.5 per cent. Find the increase per cent in the population of the whole kingdom.

106.

1. A ship, valued at \$14,500, is insured at $3\frac{1}{2}$ per cent, and her cargo, valued at \$32,000, is insured at 5 per cent. Find the whole cost of insurance.

2. Into how many pills of 325^{mg} each can a mass of 23.4^{g} be made?

3. The solid contents of a cube is 37 cubic feet, 64 cubic inches. Find the cost of painting its outside at $33\frac{1}{3}$ cents per square foot.

4. What must be the side of a cubical cistern, which will contain exactly 1000 imperial gallons of water, if an imperial gallon contains 277.274 cubic inches?

5. If a compound consist of 1185 parts copper, 715 parts tin, and 100 parts zinc, find the percentage of each metal in the compound.

107.

1. A rectangular cistern 9 feet long, 5 feet 4 inches wide, 2 feet 3 inches deep is filled with a liquid that weighs 2520 pounds. How deep must a cistern be that will hold 3850 pounds of the same liquid, if its length is 8 feet, and its width 5 feet 6 inches?

2. Reduce to prime factors, and then find the greatest common measure of 35,035, 41,580, 24,255.

3. How many square slabs of marble 150^{qcm} on the surface will be required to pave a court whose area is 50.70^{qm}?

4. A person sells out his 3 per cent stock at $86\frac{1}{4}$, and gets $34,000; he invests one half of this sum in 4 per cent stock at 97, and the remainder in $3\frac{1}{2}$ per cent stock at 94. Find the alteration in his income.

5. If 56 cubic feet 1044 cubic inches of timber are required to floor a room $29\frac{1}{4}$ feet by $25\frac{1}{3}$ feet, what is the thickness of the boards?

108.

1. A merchant has teas worth $1.12\frac{1}{2}$ and $87\frac{1}{2}$ cents per pound respectively, which he mixes in the ratio of 3 pounds of the better kind to 2 of the poorer kind, and sells the mixture at $1.08\frac{1}{3}$ per pound. What does he gain or lose per cent?

2. How many revolutions will the wheels of a carriage make in travelling 41^{km}, if the wheels are 125^{cm} in diameter? (The circumference is 3.1416 times the diameter.)

3. In what proportion must wines worth $3, $4, $5.20, $6, per gallon be mixed, so as to give a profit of $14\frac{2}{7}$ per cent when sold for $4.80 a gallon?

4. Extract to four figures the cube root of 20.

5. If a railway train goes $27\frac{3}{4}$ miles in $2\frac{1}{2}$ hours, how far will it go in an hour?

109.

1. In what time will $2275 amount to $2673.12½ at 5 per cent, simple interest?

2. If a horse trots 23¾ miles in 2½ hours, what is his rate per hour?

3. If twelve men can build a wall 6 feet high, 3 feet thick, in 9 days, how many men would build a wall of the same length, 5 feet high, 4 feet thick, in 24 days?

4. A man pays $12,000 for 5^a of land, and sells it for $25.20 a square meter. How much does he make?

5. A river 30 feet deep and 200 yards wide flows 4 miles an hour. Find the number of cubic feet of water that passes a given point in a minute.

6. Extract to four figures the cube root of 0.002.

110.

1. A cistern has two pipes, one of which can fill it in 2 hours, the other in 3 hours. A third pipe can empty it in 5 hours. If all these are opened when the cistern is empty, in what time will it be filled?

2. A pile of wood is 8.50^m long, 2.66^m wide, 2.60^m high. How many sters of wood are there?

3. A clock is set at 12 o'clock on Monday; at noon on Tuesday it is 3 minutes too fast. What will be the true time when the clock strikes 4 on Thursday afternoon?

4. If 20 men can do a piece of work in 12 days, how many men will do another piece of work six times as great in $\frac{1}{10}$ of the time?

5. If 5 per cent be lost by selling an article at $2.50, find the gain or loss per cent by selling it at $3.12½.

6. Find the square root of 53107.2025.

111.

1. Reduce 167,948,604 square inches to acres, etc.
2. A man contracts to perform a piece of work in 30 days, upon which he employs 15 men. In 24 days it is only half finished. How many additional men must he employ to finish the work in time?
3. A cistern can be filled by a spout in 2 hours, but on account of a leak in the cistern the spout takes $2\frac{1}{2}$ hours to fill it. How long will it take the leak to empty the cistern?
4. A country, the population of which is 10 millions, has births yearly of 1 in 20, and deaths 1 in 30. What will its population be 5 years hence?
5. A beam is 14.14^{m} long. Its other dimensions are 51.6^{cm}, 174^{mm}. Find its volume.
6. If a trader sells $13\frac{1}{2}$ pounds for 14 pounds, how much per cent does he gain fraudulently?

112.

1. A wine which contains $7\frac{1}{2}$ per cent of spirit is frozen, and the ice, which contains no spirit, is removed. The proportion of spirit in the wine thus is increased to $8\frac{3}{4}$ per cent. How much water in the shape of ice is removed from 504 gallons of the original wine?
2. Find to four places of decimals the square root of 0.001 and of 0.5; and also find what numbers have 0.1 and 0.03 for their square roots.
3. The diameter of a carriage wheel is 4 ft. Two persons calculate the number of its turns in a given distance, one calling the circumference 3 times the diameter, the other $3\frac{1}{7}$ times; their results differ by 100 turns. Find the distance.
4. A package of candles which weighs 465^{g} is sold for 28 cents. What is the price of 10^{kg} of the candles?
5. Reduce to its lowest terms the product of $1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \frac{1}{25} + \frac{1}{36}$, and $\frac{3}{13} - \frac{1}{7} + \frac{8}{59}$.

113.

1. Resolve into prime factors 5940, 19,008, and 269,568, and write the greatest number that will divide them all without remainder, and the smallest number that they will all divide without remainder.
2. Divide 181.3 by 0.00037, and by 37,000.
3. Find the cost of carpeting a room 18 feet 6 inches long, 12 feet 6 inches wide, with carpet $\frac{3}{4}$ of a yard wide, at 75 cents per yard, strips running lengthwise, and 3 yards being allowed for matching the patterns.
4. If 3 men mow 20 acres in 11 days of 11 hours, how many men will it take to mow a rectangular field 384 yards long and 300 wide, in 4 days of 12 hours?
5. The difference between the simple and compound interest on a sum for 3 years at 5 per cent is $\$23.12\frac{1}{2}$. Find the sum.
6. How many hektars in a square kilometer?

114.

1. A box is 3.75^{m} long, 3.50^{m} wide, and 50^{cm} high. Find how many liters of olive oil it will hold, and the weight of the oil in kilograms, the specific gravity of the oil being 0.914.
2. If A can do $\frac{2}{3}$ of a piece of work in 4 hours, and B can do $\frac{3}{4}$ of the remainder in 1 hour, and C finish it in 20 minutes, in what time will they do it, all working together?
3. When a common fraction is reduced to a decimal, in what cases will the result be a terminating decimal, and in what cases a circulating decimal?
4. If by selling goods for \$272 I lose 15 per cent, how much per cent would I have lost or gained if I had sold them for \$336?
5. If oranges are bought at the rate of 20 for a dollar, how many should be sold for \$28 to gain 40 per cent?
6. Find the cube root of 84.9 to three places of decimals.

115.

1. If a man walk 11 yards in 5 seconds, how long will he be in walking a mile?

2. A cubic foot of water weighs 62½ pounds, and a room 18 feet 9 inches by 13 feet 4 inches is flooded to a depth of 2 inches. What is the weight of water in the room?

3. Assuming that 3 hektars contain 35,881 square yards, and that one hektar contains 10,000 square meters, find the length of a meter in yards.

4. Add together 536.421, 53,642.1, 5.36421, and subtract the result from 100,000.

5. If the price of candles 8½ inches long be 18 cents for a half-dozen, and that of candles of the same thickness and quality 10½ inches long be 22 cents a half-dozen, which kind would you advise a person to buy, and what would be the saving per cent if your advice is followed?

116.

1. Find the weight in kilograms of the air in a hall 23^m long, 16^m wide, and 10^m high, the specific gravity of air being 0.00129206.

2. A cubical block contains 9 cubic feet, 1029 cubic inches. Find the number of square yards, etc., in its surface.

3. A bar of metal weighing 100 ounces 16 dwts. is made into coins, each weighing 1 ounce 8 dwts. How many coins are there?

4. A person investing in a 3 per cent stock received 3½ per cent interest on his money. What is the price of the stock?

5. A bar of gold, weighing 196 pounds 10 ounces 10 dwts., is cased in lead, weighing 24 pounds 14 ounces. Find the weight of the whole in Avoirdupois weight.

117.

1. A merchant buys 4000 bushels of wheat, one-fifth of which he sells at a gain of 5 per cent, one-fourth at a gain of 10 per cent, one-half at a gain of 12 per cent, and the remainder at a gain of 16 per cent. If he had sold the whole at a gain of 11 per cent, he would have made $35 more. What was the cost of the wheat per bushel?

2. If 1000 square yards of land produce a load of hay, how many loads will 25 acres produce?

3. Assuming 8000 meters to be equal to 5 miles, find the number of square meters there are in an acre.

4. A person having a certain sum of money to invest finds that an investment in 5 per cent stock at 117½ will yield him $29 more interest annually than an investment in 3 per cent stock at 92¼. How much money has he to invest?

5. Find the simple interest on $281.63 at 3⅛ per cent for 4 years and 2 months.

118.

1. A freight train is 8 miles ahead of an express that travels at the rate of a mile in 1¼ minutes. 20 minutes later the express runs into the freight train. At what rate is the freight train running?

2. A man bought 240 cows at Rotterdam, paying $71.50 for each. He paid $\frac{1}{12}$ of their cost for their transportation, and exchanged them for 299 horses which he sold for $75 apiece. What did he gain per cent on his expenditure?

3. If a square field contain 10.24^{ha}, find the length of its side in meters.

4. Find the amount for $512 for 3 years at 6¼ per cent, compound interest.

5. If a field containing 5¼ acres produces 112 bushels of wheat, what is the area of a field which will produce 400 bushels of wheat at the same rate?

119.

1. Multiply 4 acres 67 square rods 19 square yards 4 square feet 72 square inches by 27.

2. What is the weight of a cubic centimeter of water? of a liter of water? of a cubic meter of water? If a cubic meter of gravel weighs 2.11 metric tons, what is its specific gravity?

3. If 7 men, working 16 days, can mow a field 1320 yards long, and 880 yards wide, what will be the length of the side of a field 1320 yards wide, which 4 men can mow in 42 days?

4. Divide 1.765 by 2470 to five places of decimals.

5. If 8 acres produce 220 bushels of corn, how much will 22 square yards produce?

120.

1. If 3 acres of land cost $465.90, how much can be bought for $6716.725?

2. From 0.315 of a gallon take 2.25 pints.

3. $19.68\frac{3}{4}$ is $2\frac{1}{12}$ per cent of what sum?

4. A, B, and C rent a farm for $270. A puts 200 sheep on it; B, 150; and C, 100. After 6 months A sells $\frac{3}{4}$ of his flock to C, and 3 months later B sells $\frac{3}{5}$ of his to A. How much of the rent should each pay at the end of the year?

5. How many times a minute does the wheel of a carriage turn, when the carriage is driven at the rate of 14^{km} an hour, and the diameter of the wheel is 120^{cm}?

121.

1. If a man walks 11^m in 5 seconds, how many kilometers can he walk in an hour at the same rate?

2. Find the cost of repairing a road 87 yards 1 foot 10 inches long, at the rate of $4 a rod.

3. A cask that weighs 236 pounds 4 ounces *just* sinks in a square cistern of water, whose edge is 2 feet 6 inches. If the cask is removed, how far will the water sink in the cistern, reckoning the weight of a cubic foot of water to be 1000 ounces?

4. A man paid $45.10, including a duty of 10 per cent, for a watch. How much was the duty?

5. If 19 men can build 38 yards of wall in 12 days, how many will build 96 yards 2 feet 3 inches in $21\frac{1}{2}$ days?

122.

1. Find the amount of $875 at the end of 1 year and 3 months, at 4 per cent per annum, compound interest, the interest accruing quarterly.

2. If 12 men build a wall 60 feet long, 4 feet thick, and 20 feet high in 24 days, working 12 hours a day, how many men will it take to build a wall 100 feet long, 3 feet thick, and 12 feet high, in 18 days, working 8 hours a day?

3. If the specific gravity of sea-water is 1.026, and that of olive oil is 0.915, what is the weight of a hektoliter of each in kilograms?

4. What must be the length of an inner edge of a cubical box which will hold 10 cubic feet?

5. An agent, charging $2\frac{1}{4}$ per cent commission, receives for his services $313. Find the amount of his sales.

123.

1. An agent received $5922 with which to purchase goods, and is allowed 5 per cent commission on his purchase. If the $5922 covers the cost of the goods and his commission, how much was his commission?

2. How much per cent above cost must a man mark his goods in order that he may take off 30 per cent from the market price, and still make 30 per cent on the cost?

3. If a pint contains $28\frac{7}{8}$ cubic inches, how many pints are there in a cubic foot of water?

4. If 14 liters of water be poured into a vessel containing 6 liters of sulphuric acid, specific gravity 1.84, and the mixture shrink to 19.944 liters, what is the specific gravity of the mixture?

5. Find 0.015 of 17 acres 130 square rods.

124.

1. If 5 needlewomen can finish a certain quantity of work in $10\frac{5}{8}$ days of $9\frac{3}{8}$ hours each, how long would it take 3 needlewomen to do twice the same work, reckoning 10 hours to the day?

2. Find the square root of 0.196 to four places of decimals.

3. Find the greatest common measure of 837, 1134, and 1347.

4. A ship carries 5 chronometers, and estimates Greenwich time by the mean time of the five. Two of them lose respectively 39 seconds in 35 days, and 4.3 seconds in 6 days; the others gain respectively 5 seconds a week, 1.3 seconds a day, and 23 seconds in 14 days. By how much will the estimated time be in error after a cruise of 176 days?

5. How many square meters of surface will 240 sheets cover, if the sheets are 303^{mm} long and 195^{mm} wide?

125.

1. A bankrupt owes $5050. His assets are $378.75. How many cents does he pay on a dollar?

2. If 36 men dig a trench 72 yards long, 4 yards wide, and 3 yards deep, how many men will be required to dig one 80 yards long, 4 yards wide, and 6 yards deep in the same time?

3. Reduce to its simplest form the expression
$$\frac{3}{7} \text{ of } \frac{4\frac{5}{9}}{12\frac{1}{3}} \text{ of } \frac{3\frac{4}{11}}{11\frac{5}{7}} \div 1\tfrac{1}{11}.$$

4. A person invests $6534 in 3 per cent stock at 90, and on the stock rising to 91 transfers his stock to $3\frac{1}{2}$ per cent stock at $93\frac{1}{2}$. How is his annual income affected?

5. Olive oil costs 60 cents a kilogram. What is the price of a hektoliter, if the specific gravity of the oil is 0.914?

126.

1. The distance between two places measured on a military map is 156^{mm}. What is the actual distance between the places if the map is made on the scale of 1 to 80,000?

2. How many horses will be required to plough 117 acres in 35 days, if 10 horses can plough 13 acres in 7 days?

3. If I buy 3090 yards of cloth at $92\frac{1}{2}$ cents per yard, and sell the whole for $3205.87\frac{1}{2}$, what is the gain per cent?

4. Find the amount of $7123.13 at 4 per cent, for 2 years and 3 months, compound interest.

5. How many bricks $8\frac{3}{4}$ inches long, $4\frac{1}{4}$ inches wide, $2\frac{1}{2}$ inches thick can be stored in a building $17\frac{1}{2}$ yards long, 10 yards wide, and $8\frac{1}{2}$ feet high?

127.

1. How many panes of glass 40^{cm} by 80^{cm} will be required for the windows of a house if the total surface of measurement of the glass in the windows is 203.52^{qm}?

2. A 20 horse-power engine pumps 40 gallons of water from a pit 100 yards deep in 3 hours. What quantity of water will an engine of 35 horse-power pump from a depth of 235 feet in 141 days, working night and day?

3. A speculator buys 280 yards of carpet, expecting to sell the whole at $1.38 a yard, and thereby make 15 per cent profit; but 40 yards being ruined, what did he gain or lose per cent by selling the remainder at the expected rate?

4. If a piece of land is bought for $3500, and a man who owns $\frac{2}{5}$ of it sells $\frac{1}{2}$ of his share for $800, how much does he gain per cent by the transaction?

5. Extract the cube root of 1.105507304.

128.

1. A tank is 1.50^{m} wide, 3.20^{m} long, and 80^{cm} deep. How many kilograms of alcohol, specific gravity 0.80, will be required to fill it one-third full?

2. How many men working for 11 cents an hour for 23 days of 9 hours can earn the same wages as 22 men working for $11\frac{1}{2}$ cents an hour for 18 days of $9\frac{1}{2}$ hours.

3. If goods cost $\$75.87\frac{1}{2}$, at what price must they be sold to gain $17\frac{1}{2}$ per cent?

4. A can mow $\frac{2}{5}$ of a field in $7\frac{1}{2}$ days, B can mow $\frac{3}{5}$ of the same field in $9\frac{1}{2}$ days. In what time can A and B together mow the field?

5. A train travels a certain distance in $4\frac{7}{12}$ hours at the rate of $16\frac{4}{5}$ miles an hour. How long will a train going $19\frac{1}{4}$ miles an hour take to travel the same distance?

129.

1. A rectangular sheet of tin of uniform thickness is 85^{cm} wide, 2.7^{m} long, and weighs 536^{g}. What is its thickness, reckoning the specific gravity of tin at 7.3?
2. I pay for 180 yards of cloth at $92\frac{1}{2}$ cents per yard, but it is measured with a yard-stick $\frac{5}{6}$ of an inch short. How much money does the seller unfairly take?
3. What must a person have invested in 3 per cent stock at $93\frac{1}{2}$, if a transfer of $\frac{2}{5}$ of his capital to 5 per cent stock at 125 would increase his income \$14.80?
4. If 20 shillings weigh 3 ounces 12 dwts. 12 grains, and contain 5 dwts. $10\frac{1}{2}$ grains alloy, how much pure silver is there in a half-crown ($2\frac{1}{2}$ shillings)?
5. Express by a common fraction the difference between $2.5\dot{3}\dot{5}$ and 2.535.

130.

1. A, B, and C rent a field for \$25.62. A puts in 15 sheep for 6 months, B 45 sheep for 8 months, C 81 sheep for 4 months. What should each pay toward the rent?
2. The top of a building 236 feet high is reached by a flight of steps, each 12^{cm} high. Find the number of steps, if a meter is taken as equal to 3 feet $3\frac{1}{3}$ inches.
3. How many ars of land in a strip 1^{km} long and 7^{m} wide?
4. An executor of an estate finds it encumbered with debts to the amount of \$4322.50 over and above its realized value of \$10,729.50. How many cents on a dollar can he pay the creditors?
5. Extract the cube root of 437.245479.

131.

1. What fraction of a pound Avoirdupois is a pound Troy, and what fraction of an ounce Troy is an ounce Avoirdupois?

2. Simplify $\left(\frac{3 \times 4\frac{1}{6}}{7\frac{1}{2} + 4\frac{2}{3}} + \frac{3\frac{1}{2} + 8\frac{5}{9}}{3\frac{7}{9} - 2\frac{1}{6}}\right) \div \frac{\frac{3}{4} \text{ of } \frac{4}{5}}{\frac{5}{4} \text{ of } 3}$.

3. Find the weight in kilograms of a bar of gold 10^{cm} long, 30^{mm} wide, and 25^{mm} thick, its specific gravity being 19.36.

4. If \$15 be gained on \$360 in 8 months 15 days, what sum will gain \$21 in 1 year 6 months?

5. For how much must a man give his note to a bank, on 4 months at 6 per cent, to obtain \$500?

132.

1. What sum will amount to \$1104.75 in 3 years at $3\frac{1}{3}$ per cent, compound interest?

2. What annual income will be produced by \$13,000 in a $3\frac{1}{2}$ per cent stock at 91?

3. If the circumference of a coach-wheel measures 17 feet 7.2 inches, how often will it turn round in travelling 8 miles 264 feet?

4. Reduce to its lowest terms $\frac{18887}{69693}$.

5. If a square meter = 1550.031 square inches, find to the fifth decimal place the number of square centimeters in a square inch, and the number of acres in a hektar.

133.

1. A tradesman's prices are 20 per cent above cost price. If he takes 10 per cent off from the bill of a customer, what per cent profit does he make?
2. If a man can do a piece of work in 77 hours, and a boy can do the same work in 121 hours, in how many hours, minutes, and seconds can they do it, working together?
3. If the cost of papering a room $8\frac{1}{4}$ yards long, $6\frac{2}{3}$ yards wide, with paper 2 feet wide at 8 cents a yard be \$14.32, find the height of the room.
4. If 3 per cent more be gained by selling a horse for \$83.25 than by selling him for \$81, what is the cost of the horse?
5. If a cubic yard $= 0.76453^{\text{cbm}}$, find to the fifth decimal place the number of cubic centimeters in a cubic inch, and the number of sters in a cord.

134.

1. By selling out \$4500 of 5 per cent stock at $112\frac{1}{2}$, and investing the proceeds in a 7 per cent stock, a person increases his income by \$168.75. What is the price of the 7 per cent stock?
2. Simplify $2\frac{3}{5}\frac{7}{3} \times \frac{4}{7}\frac{3}{7}\frac{0}{3}\frac{8}{6}\frac{9}{6}$.
3. If a gram $=$ 15.43235 grains, find to the fifth decimal place the number of pounds Avoirdupois in a kilogram and in a metric ton.
4. An article which costs \$95.76 per cwt. of 112 pounds is retailed at \$1.08 a pound. If there is a waste of 5 per cent, what is the rate per cent of profit?
5. Find the square root of 0.1 to four places of decimals.

135.

1. Find the L. C. M. of 7, 11, 21, 63, 91, 99, 117.

2. A plate of iron 137^{cm} long, 643^{mm} wide, 43.1^{mm} thick weighs 277.54^{kg}. What is its specific gravity?

3. If 135 men can dig a trench 48 yards long, 1 foot 3 inches wide, 3 feet 9 inches deep, in 5 days of 6 hours, how many men will be required to dig a trench 90 yards long, 2 feet 6 inches wide, 3 feet deep, in 27 days of 10 hours?

4. A man has £10 13*s.* 4*d.* a week in rents. His tenants cheat him out of $\frac{1}{10}$ of his rent; he pays 4*d.* in the pound for collection, and 9½ *d.* in the pound for taxes. How much a week has he to spend?

5. Divide 4900 by 0.07, multiply the quotient by 0.63, and divide the result by 0.049.

136.

1. If $\frac{5}{12}$ of a cargo be worth $750, how much is $\frac{8}{10}$ of $\frac{5}{36}$ of it worth?

2. A parcel of 5 pounds 7 ounces is carried 120 miles for 40 cents. How much will it cost to carry 16 pounds 5 ounces a distance of 90 miles at the same rate?

3. If a meter = 39.37043 inches, find to the fifth decimal place the number of centimeters in an inch, and the number of kilometers in a mile.

4. Find the cube root of 7.6 to four places of decimals.

5. A person, by selling an article which cost 60 cents a pound at 67½ cents a pound, makes 5 per cent more profit than if he had sold the whole for $267.67½. Find the amount sold.

137.

1. Find the sum of $6\frac{1}{2}$, $7\frac{4}{15}$, $8\frac{72}{125}$, 19, $10\frac{11}{75}$, $12\frac{5}{6}$.

2. A garrison of 1000 men, provisioned for 60 days, was reinforced at the end of 18 days, and the provisions were exhausted at the end of 30 days from that time. Of how many men did the reinforcement consist?

3. Two engines 40 miles apart are approaching each other at the rates of 25 and 35 miles an hour. Determine the time and place of their meeting.

4. Find the simple interest on \$2187.50 for 219 days at $4\frac{1}{2}$ per cent, reckoning 365 days to the year.

5. Find the area of a field 225^{m} long, 100^{m} wide. Express the answer in hektars and ars.

138.

1. From 2000 subtract 852.2534, and divide the remainder by 16.38.

2. If I invest \$1200 in 3 per cent stock at 72, what is my income, and what rate per cent do I get on my investment?

3. If \$36 worth of bread will be sufficient for 12 men 8 months, when corn is \$1 per bushel, how many men will require \$100 worth of bread for 12 months, when corn is $\$1.31\frac{1}{4}$ per bushel?

4. Find the time required to travel 31^{km} 150^{m}, at 1 minute 28 seconds a kilometer.

5. A broker receives \$6150 to invest in cotton at $10\frac{1}{4}$ cents a pound. His commission is $2\frac{1}{2}$ per cent for buying. How many pounds of cotton can he buy?

139.

1. A collector's commission for collecting taxes, at 1½ per cent, is $41.31. What is the sum collected?

2. How many yards of carpeting 2 feet 8 inches wide will be required for a floor 19 feet 7 inches long, 16 feet 9 inches wide, if the strips run across the room, and 2½ yards are allowed for waste in matching the pattern.

3. Find the value of a carboy (17^{l}) of sulphuric acid, specific gravity 1.841, at 5 cents a kilogram.

4. If the ratio of the circumference to the diameter be 3.1416, find the diameter of a cylinder whose circumference is 16½ feet.

5. How much more income will a person have by transferring $3975 of 3 per cent stock into 3½ per cent stock, if the price of the 3 per cent stock is 93¾, and of the 3½ per cent stock 99⅜?

140.

1. Find the bank discount upon a note of $587, given Feb. 29, 1880, for 3 months, and discounted April 30 at 6½ per cent.

2. Determine the number of cubic meters in a box 2 yards long, 1 yard wide, and 2½ feet deep, reckoning a cubic yard = 0.76453^{cbm}.

3. A reservoir is 24 feet 8 inches long, and 12 feet 9 inches wide. How many cubic feet of water must be drawn off to make the surface sink one foot?

4. Divide 200 acres into four parts proportional to the numbers 50, 35, 80, and 9.

5. Extract the cube root of 946,966,168.

141.

1. If coffee worth 66 cents, 77 cents, and 57 cents per pound be mixed in equal quantities, and the mixture sold at 70½ cents per pound, what is the gain or loss per cent?

2. If 3 men, working 11 hours a day, can reap 20 acres in 11 days, how many men, working 12 hours a day, will reap a field 360 yards long and 320 yards broad, in 4 days?

3. Find in yards the side of a square field containing 15 acres 109 square rods 3 square yards.

4. A man walks 10½ miles the first day, 16¼, 18⅙, 27⅛, 21¼ miles on the four following days respectively. He then returns home by the same road in four days. What was his average daily walk on his way home and on his whole journey?

5. How many tons of air, specific gravity 0.00129206, in a space 70^m by 50^m by 35^m?

142.

1. By selling a horse for $64.75, I lost 7½ per cent. What per cent should I have gained by selling him for $73.50?

2. The proceeds of the income tax at 5*d.* in the pound was equal to £5,250,000. How much would the proceeds be, if the tax was 5 per cent?

3. Find the number of liters in a vat 2^m by 75^{cm} by 50^{cm}. Also find the weight in kilograms of sulphuric acid, specific gravity 1.840, required to fill it.

4. One horse goes 1¼ miles in 2 minutes 26 seconds; another, 1¾ miles in 3 minutes 36 seconds. How much per cent does the first one go faster than the second?

5. Find the greatest common measure of $\frac{15}{16}$, $2\frac{1}{4}$, 4, and $5\frac{1}{3}$.

143.

1. Find the least common multiple of $\frac{1}{15}$, $2\frac{1}{2}$, 5, $6\frac{1}{3}$, and $\frac{1}{11}$.

2. By selling goods for \$116.85 I lose 5 per cent. For what should I sell them to gain $3\frac{3}{4}$ per cent?

3. A spends $\frac{1}{2}$ of his money, then $\frac{1}{3}$ of the remainder, and then $\frac{1}{4}$ of what he has left. He finally has \$25. How much had he at first?

4. Make out a bill and receipt it, and show how much change there will be from a twenty-dollar bill:

   $3\frac{1}{2}$ cwt. of coal, at 21 cents a cwt.; 13 pounds of cheese, at $15\frac{1}{2}$ cents per pound; $2\frac{3}{4}$ pounds of tea, at 80 cents per pound; 17 pounds of sugar, at 11 cents per pound; $3\frac{1}{2}$ yards of flannel at 47 cents per yard; 29 yards of gingham at $21\frac{1}{2}$ cents a yard.

5. Find the number of sters in a pile of wood 4.50^{m} long, 2^{m} wide, and 2.50^{m} high.

144.

1. If 7 men earn \$31 in $9\frac{1}{4}$ days, how much will 17 men earn in $20\frac{1}{7}$ days?

2. Two persons have each a capital of \$12,000. The one invests in 3 per cent stock at $90\frac{5}{8}$; the other in 5 per cent stock at $103\frac{3}{4}$. What is the difference in their incomes?

3. If I buy 14 sheep for \$157.29, and sell 6 of them for \$7.20 each, for how much a head must the remainder be sold, that I may gain 4 per cent on the whole?

4. Find the G.C.M. of 1908, 936, 630, 21,294, 306.

5. A hektoliter of rape-seed weighs 63^{kg}, and 32^{l} of oil can be extracted from it. How many kilograms of the seed will it take to make a hektoliter of the oil?

145.

1. The volume of a cube is 2 cubic yards 14 cubic feet 145 cubic inches. Find its edge, and also its diagonal to two places of decimals.

2. By using false weights a grocer receives 17 cents instead of 16 cents. Find the number of ounces in his false pound, and his gain per cent.

3. A railway pays $3\frac{1}{4}$ per cent dividend. At what price will its shares give $4\frac{1}{2}$ per cent to a purchaser?

4. A person sells his 3 per cent stock for $73\frac{1}{8}$, and buys with the proceeds $3\frac{1}{2}$ per cent stock at $81\frac{1}{4}$, thereby increasing his income $4.50. How much 3 per cent stock has he?

5. Reduce 150 hektars to acres, supposing a square meter equal to 1.196 square yards.

146.

1. A profit of $127.60 is made by selling 2552 pounds of butter at 45 cents a pound. Find the cost per pound and the gain per cent.

2. For what sum must I insure goods worth $2192 at $2\frac{1}{2}$ per cent, so as to cover their value and the premium paid?

3. If $11.20 worth of paper is required for a room 25 feet 3 inches long, 19 feet 9 inches wide, and 12 feet high, when the paper is $\frac{3}{4}$ of a yard wide, find the cost of each yard of paper.

4. Find the price of paving a courtyard 25.34^{m} long, 18.36^{m} wide, at $1.08 per square yard. (Square meter = 1.196 square yards.)

5. Find within an inch the diagonal of a square field containing $3\frac{1}{8}$ acres.

147.

1. Find the difference between 30 chains, 15 links, and 126 rods. Express the answer in yards and decimal of a yard.

2. Find the number of feet, board measure, in a stick of timber 15 inches square and 32 feet long.

3. A watch is 10 minutes too fast at noon on Monday, and loses 3 minutes 10 seconds a day. Find the time indicated by the watch when the true time is a quarter past ten on the Sunday morning following.

4. Find the cost of 5 acres 127 square rods 88 square yards at $\$161.33\frac{1}{3}$ per acre.

5. Find the weight in metric tons of a block of stone 12.37^{m} long, 7.14^{m} wide, 83^{cm} thick, if the specific gravity of the stone is 2.5.

148.

1. From two places which are 154 miles apart two persons set out to meet each other, one walking at the rate of 3 miles in 2 hours, the other 5 miles in 4 hours. In how many hours will they meet?

2. A regiment was reduced to 520 men after engaging in two battles, in the first of which it lost 1 man in every 25, and in the second $\frac{5}{19}$ of the remainder. How many men were there at first?

3. Find the cube root of 11 to four places of decimals.

4. Frenchmen, on the average, consume yearly 1160^{g} of coffee and 9^{g} of tea; and Englishmen, 473^{g} of coffee and 1679^{g} of tea. If tea be $3s.$ and coffee $1s.$ $8d.$ per pound, and a franc be worth $10\frac{1}{2}$ $d.$, find in francs the value of an Englishman's consumption above a Frenchman's.

5. Find the value of 2 pounds 5 ounces 8 dwts. 4 grains of silver at $\$125$ an ounce.

149.

1. Find the cost of 30 3-inch planks, 24 feet long and 11 inches wide, at $15 per M.

2. An agent sells 2200 barrels of flour at $4.50 a barrel, and charges 2½ per cent commission. He invests the proceeds in steel at 1½ cents a pound, charging 1½ per cent commission. What is his entire commission?

3. Two circular gold plates, each 1 inch thick and 6 and 8 inches in diameter respectively, are melted into one plate of the same thickness. Find the diameter of this plate, knowing that the area of a circle varies as the square of its diameter.

4. Find the cube root of 0.25 to four decimal places.

5. How many miles will be travelled in 1 hour 28 minutes 21 seconds at the rate of 50^{km} an hour?

150.

1. An agent sells 1000 barrels of flour at $5.50 a barrel, and charges 2½ per cent commission; expenses for freight, etc., are $500. With the net proceeds he buys sugar at 6¼ cents a pound, charging 2½ per cent commission. How much sugar does he buy?

2. Find the number of feet board measure in 25 joists, each 6 inches by 4 inches, and 14 feet long.

3. Find the value of 3 pounds 8 ounces 16 dwts. 12 grains of gold at £3 17*s.* 10½*d.* per ounce.

4. A pond whose area is 3 acres is frozen over with ice to the uniform thickness of 6 inches. If a cubic foot of ice weighs 896 ounces, find the weight of ice on the pond in long tons.

5. A jar full of water weighs 1.325^{ks}; filled with mercury, it weighs 12.540^{ks}. What is the capacity of the jar and its weight? The specific gravity of the mercury is 13.59.

EXAMINATION PAPERS IN ARITHMETIC.

I.

BOWDOIN COLLEGE, BRUNSWICK, ME.

Examination for Admission, June, 1883.

1. Find the difference between 0.0000005 and 0.00005.
2. Change 0.03125 to a common fraction in its lowest terms.
3. If the year is considered 365.25 days instead of 365.242264, how great will the error be in 1880 years?
4. The dividend is 7423.973, the quotient is 12.130, and the remainder is 0.413. What is the divisor?
5. What is the cost of 60.5 tons of coal when 0.9 of a ton cost $6.66?
6. Find the square root of 6.7081. Of 0.004 to the nearest ten thousandth. Of $\frac{49}{529}$.
7. Reduce 6453^{m} to kilometers. 4.15^{m} to centimeters. 6.45^{l} to milliliters. How many decigrams does a dekaliter of pure water weigh?

II.

DARTMOUTH COLLEGE, HANOVER, N.H.

Entrance Examination, June, 1883.

1. Find the G.C.D. of 66, 308, and 506.
2. Divide $\frac{3\frac{1}{2}}{7\frac{1}{2}}$ by $\frac{\frac{1}{2}+\frac{1}{3}}{\frac{1}{2}-\frac{1}{3}}$.

3. Give the value of the kilometer in feet; of the kiloliter in gallons; of the kilogram in pounds.

4. If there is a gain of $12\frac{1}{2}$ per cent on tea at 90 cents per pound, what would be the gain per cent at 84 cents per pound?

5. Find $\sqrt{\frac{1.23}{0.0625}}$ to four decimal places.

III.

BROWN UNIVERSITY, PROVIDENCE, R.I.

Examination for Admission, June, 1883.

1. Reduce $\frac{1}{2}$ of 6 per cent of $1.05 \div \frac{3}{25}$ of $\frac{7}{10}$ to the simplest form.

2. If 17 men can reap a field in 9 days, how long would it take to reap half of it if 5 men refuse to work?

3. A man bought 200^{m} of cloth in France at $16\frac{1}{4}$ francs a meter; he paid $12\frac{1}{2}$ cents a yard for duty and freight, and sold it in Boston at $\$4.62\frac{1}{2}$ a yard. What was the gain? (1 franc = 19.3 cents.)

IV.

MASS. INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

Entrance Examination, June, 1882.

1. Find the L.C.M. of 105, 476, and 306.

2. A grocer makes a mixture of which 21.5 pounds contains $\frac{1}{2}$ pound of rye, 12 pounds of wheat, 5 pounds of oats, and 4 pounds of barley. How much of each ingredient will be contained in 100 pounds of the mixture?

3. Reduce to a decimal fraction $\frac{3\frac{1}{5}}{0.025}$, and from it subtract 0.01 of $\frac{1}{4}$.

4. In how many days will \$3245 gain \$80 at 7 per cent, simple interest?

5. Find the G.C.D. of 119 and 231.

6. Find the cube root of 0.012326391.

7. How many liters are contained in a cubical box 13 inches long, 13 inches wide, and 13 inches deep on the inside? (Given that $1^m = 39.37''$.)

8. How many grams of distilled water will such a box contain?

V.

Entrance Examination, Sept., 1882.

1. Reduce $\frac{3\frac{1}{3} - 2\frac{1}{5}}{9\frac{2}{7} + 5\frac{1}{4}}$ to its simplest form.

2. Reduce $\frac{7\frac{1}{2}}{\frac{1}{8}}$ to a decimal fraction.

3. A and B together have \$136, and $\frac{3}{8}$ of A's money is equal to $\frac{3}{4}$ of B's. How much has each?

4. At \$6.25 per ton, how many tons of coal can I buy for \$1000, and allow $2\frac{1}{2}$ per cent commission?

5. Find the square root of 0.00028562 to ten-thousandths.

6. Floor 10^m by 6.5^m, carpet 90^{cm} wide; find cost of carpet at \$1.25 per meter.

7. In a parallelogram, given base $= 640^{dkm}$, altitude $= 180^{dkm}$; find area in hektars.

8. A cylindrical vessel 1^m high is made of sheet-iron 2^{cm} thick, and holds 100^l. What is its outer diameter?

VI.

HARVARD COLLEGE, CAMBRIDGE, MASS.

Examination for Admission, June, 1883.

1. Find the difference between $3\frac{1}{4} \times 6\frac{12}{13}$ and $\frac{\frac{5}{6}+\frac{8}{9}}{7\frac{3}{4}}$.
2. A field is $38\frac{7}{50}$ rods long, and $37\frac{1}{2}$ rods wide. Find its area in acres and square rods. (Acre = 160 square rods.)
3. Find all the factors common to 1001 and 616.
4. The distance from Boston to Albany is 320^{km}. Find the distance in miles, assuming the meter to equal $3\frac{7}{25}$ feet.
5. A man, travelling 9 hours a day, goes 234 miles in 15 days. How far can he go in 30 days, travelling 8 hours a day?

VII.

YALE COLLEGE, NEW HAVEN, CT.

Examination for Admission, June, 1883.

1. Divide 82.1 by 41, 8.21 by 0.41, and 0.821 by 410. Carry the result in each case to four decimal places.
2. Find the value to three decimal places of $\sqrt{(0.146)^2+(0.063)^2}$.
3. Divide $\frac{3\frac{2}{3}+\frac{6}{5}+1\frac{1}{12}}{\frac{2}{3}\text{ of }5\frac{7}{8}} \times \frac{1}{\frac{4}{5}}$ by $\frac{133}{141}$.
4. Some sugar is adulterated as follows: $\frac{8}{10}$ is worth 8 cents per pound, $\frac{4}{9}$ is worth 10 cents per pound, $\frac{2}{15}$ is worth 12 cents per pound, and the remainder, 33 pounds, is sand. What is the mixture worth per pound?

5. Bank stock which sells at 170 pays an annual dividend of $12\frac{1}{2}$ per cent. What rate of interest does a buyer receive?

6. Find the depth in meters of a cubical cistern which has a capacity of $30{,}000^{l}$. Give the result to three decimal places.

VIII.

SHEFFIELD SCIENTIFIC SCHOOL, NEW HAVEN, CT.

Entrance Examination, June, 1883.

1. Find the G.C.D. of 36,864 and 20,736.

2. Multiply $\frac{8}{4}$ of $\frac{8\frac{4}{5}}{6\frac{2}{5}}$ by $\frac{4}{9}$ of $\frac{\frac{3}{7}}{16}$.

3. (i.) Give the table of metric weights.
   (ii.) A cubical cistern holds 1331^{kg} of water; what is the length of an inner edge?

4. Divide 67.56785 by 0.035, and multiply the result by $\frac{7}{8}$. Explain the position of the decimal point after division.

5. How much money should be received on a note of \$1000, payable in 4 months, discounting at a bank where the interest is 6 per cent?

6. If a man travel 117 miles in 15 days, employing only 9 hours a day, how far would he go in 20 days, travelling 12 hours a day?

7. Extract the square root of 10 to five places.

IX.

Entrance Examination, Sept., 1883.

1. (i.) Select the prime numbers between 50 and 100.
   (ii.) What is the least number that can be exactly divided by $\frac{1}{15}$, $2\frac{1}{2}$, 5, $6\frac{1}{3}$, and $\frac{1}{11}$?

2. Reduce 0.00096 to its simplest equivalent common fraction.
3. 7465 is $33\frac{1}{3}$ per cent of what number?
4. A broker bought 84 shares of railroad stock at 19 per cent discount. He sold 35 shares at $27\frac{1}{2}$ per cent discount, and the balance at 8 per cent discount. Did he gain or lose, and how much?
5. Calculate the cube root of 3.7 to five decimal places.
6. Give the approximate value of the meter in feet; of the kilogram in pounds Avoirdupois.
7. Find the weight in kilos of 15 gallons of water.

X.

Amherst College, Amherst, Mass.

Examination for Admission, June, 1883.

1. From 10 take six millionths.
2. Divide 3.6412 by 400.
3. Reduce 0.0625 to a common fraction in its lowest terms.
4. Find the G.C.D. of 1235 and 1495.
5. How many rods of fence will be required to enclose 640 acres of land in a square form?
6. What is the difference in time between Boston and San Francisco, the longitude of the first being W. 71° 3′ 30″, and the second, W. 122° 24′ 40″?
7. Sold a pair oxen for $175, and gained 5 per cent; what per cent would I have gained if I had sold them for $200?
8. If 6 men in 15 days earn $135, how many dollars will 9 men earn in 18 days?
9. What is the weight of 27^{hl} of water?

XI.

WILLIAMS COLLEGE, WILLIAMSTOWN, MASS.

Entrance Examination, June, 1883.

1. Reduce $\frac{5}{7}$ to a decimal, and extract the square root to three places.
2. How long must the side of a square lot be to contain one acre of ground?
3. Find the interest on \$1385.50 for 23 days at 7 per cent.
4. Reduce 532^{km} to miles.

XII.

TUFTS COLLEGE, COLLEGE HILL, MASS.

Examination for Admission, June, 1881.

1. Find the L.C.M. of 108, 217, 54, 31.
2. Find the prime factors of 927, 342, 861. With these prime factors get the G.C.D. of the given numbers.
3. Reduce the fraction $\dfrac{8\frac{1}{2} \times \frac{7}{13}}{\frac{1}{12} \text{ of } \frac{3\frac{1}{2}}{\frac{4}{5}}} \div \dfrac{\frac{1}{3}}{\frac{3}{4} \text{ of } \frac{7}{11}}$.
4. If the rate of discount is 5 per cent per annum, how much can be obtained on a note for \$600, payable in 4 months, discounted at a bank?
5. If from the retail price of a book 20 per cent is deducted, and a discount of 10 per cent is made on the balance, and then the book sells for \$1.33, what is the retail price?
6. What is the meter? Name its subdivisions. In 9780^{m} how many kilometers? Give the units of volume in the metric system; also, of weight.
7. What weight of mercury will a vessel contain whose capacity is 20^{ccm}, the mercury being 13.5 times as heavy as water?

XIII.

TRINITY COLLEGE, HARTFORD, CT.

Examination for Admission, June, 1883.

1. From the sum of $3\frac{3}{4}$ and $4\frac{5}{6}$ subtract $6\frac{6}{7}$, multiply the difference by $\frac{3}{5}$ of $\frac{27}{40}$ of 88, and find what fraction the product is of 999.
2. Find the amount of $342.42, from Feb. 5, 1879, to March 15, 1881, with interest at 7 per cent; and reduce it to pounds sterling?
3. What is the weight of water in a tank, if it would take 98 minutes to empty it, at the rate of 8.7[1] a minute? If it were filled with oil at $18.75 a hektoliter, what would the contents be worth?

XIV.

WESLEYAN UNIVERSITY, MIDDLETOWN, CT.

Examination for Admission, June, 1883.

1. Express the value of $\dfrac{\frac{1}{2} - \left(\frac{1}{2\frac{2}{3}} \text{ of } \frac{3}{7\frac{1}{2}} \text{ of } \frac{5}{6}\right)}{32}$ exactly as a decimal.
2. What was the amount due January 15, 1883, on a note for $175, dated April 1, 1882, bearing $5\frac{1}{2}$ per cent interest?
3. A merchant sold $\frac{1}{2}$ of a certain lot of goods at a gain of 18 per cent, $\frac{1}{3}$ at a loss of 5 per cent, and the remainder at half cost. Did he lose or gain? What per cent?
4. Extract the square root of 0.01952, carrying the result to four places of decimals.

5. What is the cost of digging a cellar 3^{dkm} wide, 5^{dkm} 4^{m} long, and 2^{m} 6^{dcm} deep, at the rate of 50 cents a ster?

6. Two men undertake to do a piece of work for $6.00. One could do it alone in 5 days, the other in 8 days. With the assistance of a boy, they finish it in $2\frac{2}{3}$ days. How should the money be divided?

XV.

CORNELL UNIVERSITY, ITHACA, N.Y.

Entrance Examination, June, 1882.

1. Define: an abstract number, the prime factors of a number, a quotient, a mixed number, cube root, percentage, bank discount, compound interest.

2. Get the sum of five, five-tenths, thirty-seven thousandths, one-thousand millionths, XIX, MDCCCLXXXI, $0.\dot{1}\dot{8}$.

3. Find all the common divisors of 225, 2025, 8100.

4. Divide $\frac{4}{5}$ of 91 by $\frac{10}{27}$ of 637.

5. What is the amount, at compound interest, of $500 for 2 years 6 months, at 7 per cent?

6. Get the square root of 530 to three decimal places, and give the reasons for the several steps in the work.

7. Give the common and the metric tables for liquid measure?

8. How many liters in 10 gallons, 3 quarts, 1 pint, 3 gills, the gallon being 231 cubic inches, and the meter 39.37 inches?

XVI.

STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N.J.

Specimen Entrance Examination Paper.

1. What is a prime number?
2. Find the L.C.M. of 36, 48, and 72. Why can it not be found by first dividing by 36?
3. Find the G.C.D. of 120, 228, and 720.
4. If John sells a book for 110 cents, and thereby loses 12 per cent, what did the book cost him?
5. Find the square root of 0.4 to three places.
6. Find the cube root of 0.8.
7. Multiply 3 hundredths by 300 thousandths.
8. Divide 300 thousandths by 3 hundred-thousandths.

XVII.

MADISON UNIVERSITY, HAMILTON, N.Y.

Entrance Examination, June, 1882.

1. From $\dfrac{10.7+\dfrac{15.15}{2.1}}{3.21+\dfrac{3}{5}}$ subtract $\dfrac{5.85-4.002}{3\frac{1}{3}+\dfrac{9.72}{0.03}}$, obtaining the result to three places of decimals.
2. Extract the square root of 102.002 to two places of decimals.
3. What is the interest on $1584 for 1 year, 2 months, and 20 days at 7 per cent?

XVIII.

VASSAR COLLEGE, POUGHKEEPSIE, N.Y.

Specimen Examination Paper for Admission.

1. Find the greatest common divisor of 256, 480, and 1296.

2. What is the value of $\left(\frac{8-.4}{2}+\frac{16-.8}{4}-\frac{5}{2}\right)\times 7\frac{7}{10}$?

3. What is the sum of $\frac{\frac{3}{5}\text{ of }\frac{5}{6}}{\frac{1}{2}}$ and $\frac{\frac{4}{7}\text{ of }\frac{7}{12}}{\frac{4}{5}\text{ of }2\frac{1}{4}}$?

4. Divide two thousand five hundred one and four-tenths by four thousand one hundred twenty-five ten-millionths. Divide 1.29136109 by 184.3, and write the quotient in words.

5. A gentleman bought a yacht for $3500, and sold it at a loss of 20 per cent; the buyer sold it at a gain of 25 per cent; what did the latter receive for it?

6. What sum of money, at 10 per cent compound interest, will amount to $8651.50 in three years?

7. A cistern is 4^{m} long, 24^{dm} wide, and 80^{cm} deep. How much water will it hold in cubic *meters*? *In liters*?

8. The longitude of St. Petersburg is 39° 19′ east; of New York 74° 41′ west; when it is one o'clock in the afternoon at St. Petersburg, what time is it at New York?

9. Extract the square root of 4.932841.

XIX.

COLLEGE OF NEW JERSEY, PRINCETON, N. J.

Examination for Admission, Sept., 1883.

1. Divide $\frac{0.6}{15}+\frac{7}{9}$ by $\frac{3.71}{630}$.

2. State and demonstrate a rule for finding the greatest common divisor of any set of integers; and make use of it to find the greatest common divisor of 847, 1331, and 1573.

3. Prove that any circulating decimal may be reduced to a rational fraction. To what fraction is the circulating decimal $0.\dot{5}\dot{7}$ equal?

4. Two bodies let fall at different instants from the same point are found, $\sqrt{\frac{5000}{981}}$ seconds after the latter of them started, to have fallen, the one 25^{m}, the other 100^{m}. These distances being to one another as the squares of the times during which the bodies have been falling, how many seconds must the one body have started before the other?

5. What per cent is 3 of 6? What is the number to which if 2 per cent of itself be added the sum is 516?

6. The amount of a certain principal at a certain rate of interest for 6 months is \$949.76, and for 1 year at the same rate is \$1003.52. Required the rate per cent and principal.

7. The dimensions of a room are, length $4^{m}\ 1^{dm}$, breadth $3^{m}\ 2^{cm}$, and height $3^{m}\ 1^{mm}$. Find its cubical contents (in kilosteres) and the area of its walls (in centares).

XX.

JOHN C. GREEN SCHOOL OF SCIENCE, PRINCETON, N.J.

Entrance Examination, Sept., 1883.

1. Simplify $\frac{2\frac{3}{4}+2\frac{7}{8}}{4\frac{3}{4}-3\frac{1}{7}}$.
2. Find the G.C.M. of 252, 315, 420, and 504.
3. Find the square root of 0.434 to three decimals.
4. If I sell goods at 4 per cent commission, and receive \$60, what amount have I sold?
5. Find the edge of a cubical can which will hold 27.57^{kg} of sulphuric acid, whose specific gravity is 1.8.

XXI.

UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA, PA.

Examination for Admission, June, 1882.

1. Simplify $\frac{5\frac{5}{8}\div\frac{2}{3}}{1\frac{1}{2}\text{ of }\frac{5}{9}-10\frac{1}{3}}\times\frac{2}{5}\text{ of }\frac{1\frac{1}{2}\text{ of }4\frac{1}{6}}{13\frac{7}{8}\text{ of }5\frac{1}{8}}-\frac{1}{2}+\frac{2}{27}$.
2. Simplify $\frac{5\frac{1}{3}-0.042-2.4+7\frac{5}{6}}{16\frac{2}{15}\div 60\frac{1}{2}}$.
3. Simplify $0.\dot{6}\text{ of }3.3+\frac{1.75}{2.625}\text{ of }17+0.4\text{ of }5.75-\frac{1.\dot{7}14285}{2.\dot{0}95238}$.
4. Extract the square root of 5683 to four places of decimals.
5. A rectangular piece of ground is $32^{m}\ 7^{dm}$ long, and $19^{m}\ 5^{cm}$ broad. Find the cost of enclosing it with a path $1^{m}\ 5^{dm}$ broad, at 3 francs 5 centimes a square meter. (i.) Path outside of the ground; (ii.) path part of ground.
6. A house cost \$5000, and rents for \$25 a month, with \$25 to pay annually for repairs and \$50 for taxes; what is the difference in the income from this and from the same money invested in 6 per cent stock at 96?

XXII.

UNIVERSITY OF MICHIGAN, ANN ARBOR, MICH.

Examination for Admission, June, 1883.

1. Reduce $\frac{2\frac{1}{3}+5\frac{1}{2}}{\frac{7}{6}}$ to a simple fraction, and state the process and principles.
2. Reduce 2 years 5 months 12 days to years and decimals of a year.
3. Extract the square root of 0.4.
4. Give the denominations used in linear measure in the metric system.
5. How are the measures of capacity and of weight in the metric system related to the linear measures?

XXIII.

LAKE FOREST UNIVERSITY, LAKE FOREST, ILL.

Entrance Examination, June, 1882.

1. Add ten thousand and one millionth; four hundred thousandths; ninety-six hundredths; forty-seven millions sixty thousand and eight billionths.
2. Define integer, compound number, the power of a number, a fraction. How many classes of fractions?
3. Find the interest of \$375.75 for 4 years 5 months and 25 days, at $4\frac{1}{2}$ per cent.
4. If the wages of 72 men for 5 days is \$450, how many men may be hired for 12 days for \$540?
5. A can build a wall in $18\frac{3}{4}$ days, B in $31\frac{1}{4}$ days; how long will it take both together to build it?

6. What is the present worth of $3471.50, due 3 months and 9 days hence, at 7 per cent?

7. What is the interest at 4½ per cent of $360.45, from July 4, 1873, to November 3, 1875, allowing a credit of $75, paid October 5, 1874?

8. Reduce to equivalent fractions, having a common denominator, $\frac{2}{3}$ of $\frac{2}{4}$, $2\frac{3}{8}$, $5\frac{2}{5}$, $\frac{2}{5}$ of $\frac{1}{3}$ of $3\frac{1}{2}$.

9. On what principal at 7 per cent, in 1 year and 3 months, will the interest be $15.40?

10. Extract the cube root of 225,866,529.

XXIV.

EDUCATION DEPARTMENT, ONTARIO.

Examination for Admission to High Schools, June, 1883.

1. What is the object of division? Write down the relation connecting the divisor, dividend, quotient, and remainder.

Divide one hundred and eight billion four hundred and nineteen million seven hundred and sixteen thousand and one, by eighteen million seven hundred and forty-eight thousand and five.

2. Find, by "casting out nines," whether the following is correct: 349,751 × 28,637 = 10,015,819,397.

Find the weight of 500,000 bricks at 4 pounds, 2 ounces each, and the cost, in dollars and cents, at 27*s.* 6*d.* a thousand, allowing 4*s.* 2*d.* to make a dollar.

3. A merchant received from England the following invoice in sterling:

375 tons iron plates, at £8 15*s.* 6*d.*; 107½ tons bar iron, at £11 14*s.*; 10 tons bulb iron, at £10 10*s.*; 17 tons T iron, at £15 10*s.*; 48 tons steel, at £18 7*s.* 6*d.*; 15 tons rivets, at £11 1*s.* Find the amount of this invoice in Canadian currency, allowing the shilling sterling to be equal to 24⅓ cents.

4. At $1.75 per rod, what will it cost to fence a piece of land 63.5 rods long, and 27.75 rods wide?

5. Simplify $1 - \frac{1}{6} + \frac{1}{24} - \frac{61}{5040} + \frac{277}{72576} = \frac{314513}{362880}$; and $\frac{4\frac{7}{10} + 5.\dot{8}\dot{1} - 2.5}{4\frac{7}{10} \text{ of } 32 \text{ of } 0.\dot{4}\dot{5}} = \frac{441}{3760}$.

6. Gunpowder is composed of nitre, charcoal, and sulphur, in the proportion of 15, 3, and 2. A certain quantity of gunpowder is known to contain 20 cwt. of charcoal; find its weight, and also the weight of nitre and of sulphur it contains.

7. Bought 360 gallons of wine at $2.60 a gallon; paid for carriage, $17.20, and for duties, $86.50. If $\frac{3}{20}$ of it be lost by leakage, at what price must the remainder be sold to gain $50 on the whole transaction?

8. Find the interest on a note for $257.81, dated January 3, 1883, and paid April 6, 1883, at 8 per cent per annum.

9. The length of a second's pendulum is 39.37079 inches; if 64 French meters are equal to 70 yards, by what decimal of an inch will the length of a second's pendulum differ from one meter?

10. At what times between 4 and 5 o'clock are the hands of a clock (i.) coincident? (ii.) at right angles?

XXV.

EDUCATION DEPARTMENT, ONTARIO.

Examination of Third Class Teachers, July, 1883.

1. Add together $\frac{3}{7}$ of £13, $\frac{1}{8}$ of $\frac{1}{2\frac{4}{5}}$ of $\frac{3}{5}$ of £2 12*s.*, and $\frac{5}{7}$ of 9*d.*

   Reduce 13*s.* $4\frac{1}{2}$ *d.* to the decimal of 19*s.* 6*d.*

2. Find by practice the value of 8596 pounds, at £10 18*s.* $7\frac{1}{2}$*d.* each.

3. A person borrows $500 on April 10, and on June 22 pays his debt with $510.20. At what rate per cent per annum was he charged interest?

4. A man having a certain sum of money to invest has an opportunity of purchasing 7 per cent stock at 95, but delays until it has risen to 110. What per cent is his income less than if he had purchased at the first price?

5. At an international exhibition, one country was awarded 5 gold, 9 silver, and 11 bronze medals; and another, 4 gold, 15 silver, and 10 bronze. Find a ratio of values for such medals that these countries may be regarded as equally fortunate.

6. In a box there is a certain number of sovereigns, three times as many guineas, and twice as many marks (13*s.* 4*d.*) as guineas. The entire amount in the box is £815. How many coins of each kind are there?

7. Find when first after 2 o'clock the hour and minute hands of a clock make an angle of 60 degrees with each other.

8. For each of three succeeding months the population of a north-west town rose 50 per cent; and at the end of the third month was 2700. What was the population at the beginning of the time?

9. Leap year is omitted once in every century, except those centuries whose number is divisible by 4. What is the average length of a year?

10. A cube is formed of a certain number of pounds Avoirdupois of a substance, and the same number of pounds Troy of the same substance. What proportion will a side of the cube bear to a side of a cube formed of the same number of pounds as before, but all Avoirdupois? (175 pounds Troy = 144 pounds Avoirdupois.)

XXVI.

EDUCATION DEPARTMENT, ONTARIO.

Examination of Second Class Teachers, July, 1883.

1. Prove that $\frac{1}{4}$ of $\frac{3}{7} = \frac{3}{28}$.
Simplify $(2\frac{2}{7}$ of $3\frac{1}{16}) + \frac{4}{9} - (1\frac{1}{8}$ of $1\frac{5}{16}) - (1\frac{3}{4}$ of $4\frac{4}{7}$ of $\frac{3}{14})$.

2. The pendulum of one clock makes 24 beats in 26 seconds; that of another, 36 beats in 40 seconds. If they start at the same time, when first will the beats occur together?

3. A can do as much work in 4 hours as B in 6; and B in $3\frac{1}{2}$ as C in 5. A does half a certain piece of work in 12 hours; in what time can it be finished by B and C, working separately equal times, and C succeeding B?

4. A note for $500, made March 9, at 3 months, is discounted April 11, at 8 per cent. What is received for the note? (True discount.)

5. The unclaimed dividends on a certain amount of stock which pays 6 per cent per annum amounted in 3 years to $1152. The stock was sold at a discount of 12½ per cent on its par value. What sum was realized?

6. Teas at 3*s.* 6*d.*, 4*s.*, and 6*s.* a pound, are mixed to produce a tea worth 5*s.* a pound. What is the least integral number of pounds that the mixture can contain?

7. A man buys 150 pounds of sugar, and, after selling 100 pounds, finds he has been parting with it at a loss of 5 per cent. At what rate per cent advance on the cost must he sell the remaining 50 pounds that he may gain 10 per cent on the entire transaction?

8. Each member of a pedestrian club walks as many miles as there are members in the club, and the expense of the trip is for each member as many pence per mile as there are members in the club. The total expense is £50 13*s.* 11*d.* How many members are there?

9. The hour, minute, and second hands of a watch are on concentric axes. When first after 12 o'clock will the direction of the second hand, produced backwards, bisect the angle between the hour and the minute hands?

XXVII.

EDUCATION DEPARTMENT, ONTARIO.

Examination of Third and Second Class Teachers, July, 1883. — *Mental Arithmetic.*

1. A hall-way is 90 inches wide, and takes 25 square yards of oil-cloth to cover it. How long is it?

2. A gentleman travels from Toronto to Montreal and back. He goes at an average rate of 33 miles per hour, and returns at an average of 30 miles per hour, and he finds that he occupied one hour longer in returning than in going. Find the distance from Toronto to Montreal.

3. A can do a piece of work in 7 days, and B can do it in 8 days. A works at it for $2\frac{1}{2}$ days, and B works at it for 3 days. C then finishes it in $3\frac{3}{4}$ days. In how many days could C have done the whole work alone?

4. By selling an article for $21 I would lose $12\frac{1}{2}$ per cent. At what should I sell it in order to gain $12\frac{1}{2}$ per cent?

5. A merchant marked his goods at an advance of 60 per cent on cost. He gave one of his customers a discount of 15 per cent off the marked price. What was his gain on $6.80 received from that customer?

6. How much stock must I sell out of the $3\frac{1}{2}$ per cents, at 84, to enable me to buy $7700 4 per cent stock, the value of the stock being proportional to the dividends they pay?

XXVIII.

EDUCATION DEPARTMENT, ONTARIO.

Examination of First Class Teachers, July, 1883.

1. Define a recurring decimal, and classify the several kinds.

   Prove, in any way, a rule for converting a mixed circulating decimal into its equivalent vulgar fraction, and apply your rule to convert $0.1013\dot{2}5\dot{7}$.

2. Perform the operations here indicated, employing contracted multiplication and division, and retaining 6 decimals throughout: $\frac{0.3872+0.03172}{6146.38} \div 0.0004675$.

3. In the expression, "6 per cents are at 103," explain fully what is meant.

   A person sells a certain amount of 5 per cents for 86, and invests in the 6 per cents at 103, and by so doing changes his income by one dollar. Is the change an increase or decrease? How much stock does he sell?

4. A man buys a note, drawn for 2 years at 6 per cent interest, and which is now 6 months old, at 15 per cent true discount. After keeping it 9 months, and receiving one payment of interest, he sells it to a bank at 8 per cent bank discount. What per cent does he make upon his money while invested?

5. A, B, and C, whose rates of walking are $3\frac{1}{2}$, 4, and 5 miles an hour, respectively, walk on circular tracks whose circumferences are 8, 10, and 15 miles, respectively, and whose centres are in the same straight line. At the same instant they start from points on this line, and on the same side of the centres. Find (i.) when first they will be all on this line at the same time; (ii.) all at same time at the points from which they started; (iii.) whether they will ever be all at the same instant at points on opposite sides of the circles to the starting points.

6. Lead is 11.4 times, and zinc 7.2 times, as heavy as water. If 3 pounds of lead and 2 pounds of zinc be melted together, compare the weight of the alloy with that of water.

7. A, B, and C start at the same time and from the same point, to travel around an island 26 miles in circuit. A goes 10 miles and B 4 miles per hour in the same direction, and C goes 5 miles per hour in the opposite direction. When and where will they first be all together again?

Algebraical symbols will be allowed in the three following questions:

8. It is required to make a hollow leaden cylinder, open at both ends, 10 inches long, with its wall 1 inch thick, and which is to weigh 25 pounds. Find its outside diameter.

9. A conical vessel, 6 inches deep and 3 inches across the mouth, is filled to 5 inches with water. Find the diameter of the sphere which, when dropped into the cylinder, will raise the water so as just to fill the vessel.

10. The diagonals of a quadrilateral plane figure are 10 and 12, and they intersect at an angle of 60°. Find the area of the figure.

XXIX.

COLLEGE OF OTTAWA, OTTAWA, CAN.

Matriculation Examination. Session 1881–82.

1. What is the exact value of $\left(2\frac{3}{4} + \frac{5}{2} \text{ of } \frac{7}{2\frac{4}{5}} + \frac{\frac{4}{9}}{\frac{1}{8}}\right) \div 4\frac{85}{225}$?

2. The sum of two numbers is 240; their L.C.M. is 1728. What are the numbers?

3. Define *discount*, and find the discount on a bill of £10 due at the end of a year, at 10 per cent.

4. Find the simple interest of $442, at 4 per cent, for 5 years; and the compound interest of $500, at 3 per cent, for 2 years.

5. The sea covers $\frac{11}{14}$ of the surface of the globe. The area of Asia is $\frac{121}{277}$ of that of Europe, whilst the area of Africa is $\frac{22}{7}$; the area of America is $\frac{111}{277}$; and the area of Oceania is $\frac{3}{27}$. Africa having an area of 11,630,400 square miles, find the area of all the other parts, and that of the entire globe.

6. Prove that the product of $n(n+1)(2n+1)$ is always divisible by 6, whatever be the whole number n.

XXX.

COLLEGE OF OTTAWA, OTTAWA, CAN.

Matriculation Examination. Session 1882–83.

1. A man has 3 farms of 56, 72, and 88 acres, respectively, and wishes to fence them into the largest possible fields, having each the same number of acres. How many acres did he put in each?

2. A grocer has a 4-pound, 5-pound, 6-pound, and a 12-pound weight. What is the smallest tub of butter that he can weigh by each without a remainder?

3. A man owning $\frac{11}{16}$ of a ship worth $48,064 sold $\frac{1}{4}$ of his share. What part of the ship did he sell? What part does he still own? and what is this part worth?

4. What is the worth of a silver cup weighing 10 ounces 16 dwt., at $12\frac{1}{2}$ cents a pennyweight?

5. The longitude of Ottawa is 75° 43′ 22″ W. of Greenwich; the longitude of Washington is 77° 3′ 1″. What is the difference in time between Ottawa and Washington?

6. A lad at the age of 14 received a legacy of $5000; he then lent it at 8 per cent simple interest. What is his legacy worth when he is 21?

7. Two men hire a pasture for $50; one put in 20 horses for 12 weeks, the other 25 horses for 10 weeks. How much should each pay?

8. A milkman bought 40 gallons of new milk, at 16 cents a gallon, and 60 gallons of skimmed milk, at 8 cents a gallon, which he mixed with 12 gallons of water, and sold the whole at 24 cents a gallon. What was his profit?

9. Simplify $\frac{3\frac{7}{9} \times 1\frac{1}{17} + 8\frac{1}{12} - 3\frac{9}{16}}{5\frac{1}{3} - 7\frac{7}{8} \div 28\frac{7}{20} + \frac{1}{8}}$, $\frac{3\frac{2}{3}}{4\frac{1}{7}} \times (3\frac{5}{8} \times 5\frac{8}{7}) - 17\frac{3}{6}$, and find their sum.

XXXI.

McGILL UNIVERSITY, MONTREAL, CAN.

School Examination, June, 1883.

1. What is the meaning of *numeration? notation? addition? subtraction? multiplication? division?* Divide three hundred sixty millions nine hundred nineteen thousand eight hundred fifty-six by eighty-three.

2. What letters are used in Roman notation, and how are they combined to express numbers? Change 9909 into Roman notation.

3. What is the difference between a vulgar and a decimal fraction? Convert $\frac{17}{1875}$ into a decimal.

4. Multiply $2.60\dot{4}$ by $1.2\dot{3}\dot{4}$, and divide the result by $0.00\dot{4}$.

5. Find the value of 21 acres 3 roods 12 poles, at $45 per acre.

6. Find the L.C.M. of 3, 5, 9, 12, 17, and 20; and the G.C.M. of 441 and 693.

7. Calculate the simple interest on $580 from May 16, 1882, to October 8, 1883 (both days inclusive), at 5 per cent per annum.

8. If the wages of 12 men for 8 days of 8 hours each be $135, what will be the wages of 25 men for 12 days of 10 hours each?

9. Find the cost of planting a rectangular field measuring 34 poles 2 yards by 26 poles 3 yards, at $6.50 per square pole, leaving a path 4 feet wide all round the field.

10. If 25 pounds of tea, at 60 cents per pound, be mixed with 30 pounds, at 47 cents, find the price of the mixture per pound in order that there may be a profit of 18 per cent.

11. If a house had been sold for $7992, there would have been a gain of 8 per cent on outlay. How much per cent is lost or gained by selling it for $7511?

12. Find the distance between the opposite corners of a rectangular floor which measures 8 feet 3 inches by 12 feet 6½ inches.

XXXII.

UNIVERSITY OF CAMBRIDGE, ENG.

Second Previous Examination, Dec., 1880. — *Time allowed*, 2½ *hours.*

1. Find the G.C.M. of 2301 and 3717, and the L.C.M. of 192, 204, and 272.

2. Divide $3\frac{3}{14} - 4\frac{7}{8} + 1\frac{19}{24}$ by $1\frac{3}{8} + 5\frac{17}{21} - 7\frac{1}{14}$.

3. A kiloliter contains 35.32 cubic feet, and a gallon contains 277.274 cubic inches; how many gallons are there in a kiloliter?

4. Add together $\frac{3}{5}$ of a guinea and a half, 0.855 of a pound, and $1\frac{7}{17}$ of $2\frac{3}{7}$ of $1\frac{3}{4}$ of 18*s.* $4\frac{1}{2}d.$

5. Extract to three places of decimals the square roots of 6 and $0.2\dot{8}\dot{7}$.

6. Find as recurring decimals the square of $0.\dot{4}$, and the square root of $0.69\dot{4}$.

7. Calculate the cost of paper for a room 18 feet long, 16 feet broad, and 12 feet high, allowing 40 square feet for doors and windows, the price of the paper being 2*s.* 4*d.* per piece of 12 yards long and 21 inches broad.

8. A Cambridge Poor Rate, at 11*d.* in the pound, is made up of the Union Contribution, $5\frac{1}{2}d.$; the Borough Rate, 4*d.*; the Asylum, etc., $1\frac{1}{2}d.$ The rate on a certain property amounts to £100 8*s.* 5*d.*; how much of this is for the Borough Rate, and at what amount is the property assessed?

9. Find the difference between the amount of £1205, put out for 2 years at 5 per cent compound interest, and the present value of the same sum due 2 years hence at 5 per cent compound interest.

10. The 11.45 Exeter express from Paddington stops first at Swinden, $77\frac{1}{2}$ miles distant, at 1.12. In the whole journey, 194 miles, 15 per cent of the time is expended in stoppage, etc. At what time is the train due at Exeter?

11. What income would be derived from investing £9350 in $5\frac{1}{2}$ per cent preference stock at $137\frac{1}{2}$?

XXXIII.

UNIVERSITY OF CAMBRIDGE, ENG.

Previous Examination, June, 1881. — Time allowed, 2½ hours.

1. Arrange in order of magnitude the fractions $\frac{2}{5}$, $\frac{8}{10}$, $\frac{7}{15}$, and $\frac{9}{19}$; and find the difference between the greatest and least.

2. Simplify $\frac{\frac{1}{2}-\frac{1}{3}}{\frac{1}{2}+\frac{1}{3}}$ of $\frac{\frac{1}{2}-\frac{1}{5}}{\frac{1}{2}+\frac{1}{5}}$ of $\frac{\frac{1}{6}-\frac{1}{7}}{\frac{1}{6}+\frac{1}{7}}$ of 585.

3. Find a decimal which shall differ from $\frac{17}{21}$ by less than $\frac{1}{10000}$.

   Simplify $\frac{1.875}{2.1} \times \frac{3.5}{3.75}$.

   Find the sum of

   $2.\dot{4}$, $0.3\dot{2}$, $0.5\dot{6}7$, $7.05\dot{6}$, $4.1\dot{7}$, and $0.4\dot{3}04122\dot{2}$.

4. Calculate the value of $\sqrt{3+2\sqrt{2}}$ correctly to two places of decimals.

5. Find by practice the value of a nugget of gold weighing 3 pounds 11 ounces 18 pennyweights 4 grains at £3 17*s.* 6*d.* per ounce.

6. A lawn-tennis ground is half as long again as it is wide. The cost of levelling at 9*d.* per square yard is £176 8*s.* 0*d.* Find the cost of enclosing it with an iron railing at 7*s.* 6*d.* per yard.

7. A sum of £650 is due from A to B on a certain day, and £495 12*s.* 6*d.* is also due 7 months later. Show that, reckoning interest at 5 per cent, if A pay both debts at the end of 3 months, neither of them will lose.

8. Brussels carpet is 2 feet wide, costs 6*s.* 6*d.* a yard, and will last 5 years. Kidderminster carpet is $2\frac{1}{2}$ feet wide, costs 5*s.* a yard, and will last 3 years. Which is the cheapest, not reckoning interest on your outlay?

9. Two men and three boys can level and turf 352 yards of a cricket-ground in 4 days; and three men and two boys can complete 276 yards in 3 days. Compare the rates of working of a man and a boy.

10. A man has £7220 stock in the 3 per cent consols. When they are at $102\frac{5}{8}$ he sells, and invests in the $2\frac{1}{2}$ per cents at $90\frac{1}{8}$. Find the change in his income. (Brokerage is $\frac{1}{8}$ per cent.)

11. A steel rod, 1 foot long and 1 inch square, weighs $3\frac{1}{2}$ pounds, and will just support 50 tons. What is the greatest length of steel wire which, when hung up by one end, will just not break by its own weight?

XXXIV.

University of Cambridge, Eng.

Second Previous Examination, Dec., 1881. — *Time allowed, 2½ hours.*

1. Simplify $\dfrac{3\frac{1}{4} \text{ of } 4\frac{1}{8}}{(2\frac{1}{2} - \frac{1}{8}) \text{ of } (3\frac{1}{2} - \frac{1}{4})}$.

2. Find the difference between $\frac{5}{9}$ of 31 acres 2 roods 27 poles, and $\frac{7}{8}$ of 18 acres 1 rood 0 poles.

3. Reduce 5 days 16 hours to the decimal of a week.

   Find the value of $\dfrac{0.321 \times 0.321 - 0.179 \times 0.179}{0.321 - 0.179}$ of £5.

4. Find the square roots of $27\frac{1}{25}$ and 90,018.0009.
   A Christmas dole is given to the inhabitants of certain almshouses, consisting of as many shillings to each as there are inhabitants. The sum so expended is £9 16*s.* 0*d.* How many inhabitants are there?

5. At what rate per cent will the simple interest on £236 6*s.* 8*d.* amount to £17 14*s.* 6*d.* in $2\frac{1}{2}$ years?

6. Find the present worth of £1250 0*s.* $2\frac{1}{2}d.$ due 7 months hence at $3\frac{1}{2}$ per cent.

7. What sum of money must be invested in $4\frac{1}{2}$ per cent stock at $83\frac{7}{8}$ to bring in an income of £219? (Brokerage is $\frac{1}{8}$ per cent.)

8. A man walking 18 miles finds that in 1 hour 40 minutes the distance he has walked is $\frac{5}{7}$ of the remaining distance. Find his rate of walking.

9. A cubical cistern, open at the top, costs 15 guineas to line with lead at 1*s.* 9*d.* per square foot. How many cubic feet will it contain?

10. A man's income is increased by £200; but the income tax being reduced from 6*d.* to 5*d.* in the pound, he pays the same amount of tax as before. What is his income?

XXXV.

UNIVERSITY OF CAMBRIDGE, ENG.

Previous Examination, June, 1882.—*Time allowed,* $2\frac{1}{2}$ *hours.*

1. Reduce $\frac{4}{3}\frac{4}{1}\frac{8}{2}\frac{2}{5}$ to a decimal, and $2.48\dot{0}2\dot{7}$ to a vulgar fraction in its lowest terms.

2. Simplify $5\frac{1}{3}$ of $\dfrac{1}{1\frac{1}{3}+\dfrac{1}{2\frac{1}{4}}} \div \dfrac{4\frac{1}{5}+5\frac{1}{4}}{4\frac{1}{4}+3\frac{7}{8}}$.

3. Find the cost of 7 cwt. 2 quarters 23 pounds at £11 1*s.* 8*d.* per cwt.

4. A man who has sold tea at half-a-crown per pound, making a profit of 25 per cent, lowers his price so as to gain only 2*d.* per pound. In what ratio must his weekly sale increase that he may make twice as much as before?

5. Find the amount of £325 16*s.* 8*d.* in $3\frac{1}{2}$ years at $4\frac{1}{4}$ per cent simple interest.

6. If a bill of £932 2*s.*, due Dec. 19, be paid June 6, find the true discount to be allowed, reckoning interest at 4 per cent per annum.

7. The amount of sunshine recorded in Jersey last year, in the month of April, was 33 per cent of the possible amount; and the average length of the night in that month is 10 hours 30 minutes. Find how many hours of sunshine there were in the month.

8. The length of a side of the base of the Great Pyramid, which is square, is 500 Egyptian cubits:
   (i.) Find the area covered by it in acres, roods, etc., knowing that an Egyptian cubit is equal to 18.24 English inches.
   (ii.) Find the height of the Pyramid in cubits, having given that the height of a model of the Pyramid, the area of whose base is 8 square feet 73 square inches, is 22.225 inches.

9. Which is the more profitable stock to invest in, 3 per cent at $83\frac{1}{2}$, or $3\frac{1}{2}$ per cent at 97?

10. Two men undertake to do a piece of work for 1 guinea. One could do it alone in 6 days, the other in 7 days. With the assistance of a boy they finish it in 3 days. How should the money be divided?

XXXVI.

UNIVERSITY OF OXFORD, ENG.

Local Examination, Junior Candidates, May, 1881.
Time allowed, 2 *hours.*

Every candidate is required to satisfy the examiners in the first part of this paper. The second part is intended for those candidates *only* who offer mathematics as a subject, and is not to be attempted by any until they have done all they can do of the first part. Attention should be paid to spelling and hand-writing. No credit will be given for any answer, the full working of which is not shown.

I.

1. Express in words 90,999,090,009; and in figures, two thousand millions four hundred thousand and sixty.
2. Multiply 810,901 by 809,101; and 1 ton 0 cwt. 0 quarters 5 pounds by 449.
3. Divide 25,600,160,001 by 159,601; and £183 12*s.* $1\frac{1}{2}$*d.* by 58.
4. A field containing 18 acres 36 poles is divided into allotments, each containing 1 rood 14 poles. How many of them are there?
5. Reduce 28 quarters 5 bushels 1 peck 1 gallon to pints.
6. Simplify $\frac{3\frac{1}{7} - \frac{2}{3}}{\frac{4}{49} \times 7\frac{7}{12}}$; and divide 0.00036 by 0.006.
7. Express 2 yards 3 inches as the fraction of 1 mile 30 perches.
8. If it cost £9 5*s.* 4*d.* to carpet a room whose floor contains 278 square feet, how many square feet are there in one which can be carpeted for £12 4*s.* 8*d.*?

II.

9. Find the simple interest on £11,000 for 4.4 years at 3.15 per cent.

10. The external length, breadth, and depth of a box are 6 feet 2 inches, 3 feet 8 inches, and 2 feet, respectively, and it is made of wood 1 inch thick. Find the quantity used.

11. Two pipes running together can fill a cistern in 8 minutes, and one of them alone can fill it in 24 minutes. How long would the other alone take?

12. If 12 men, working 8 hours a day, do $\frac{4}{5}$ of a piece of work in 20 days, how many days will 15 men, working 10 hours a day, take to do $\frac{7}{8}$ of it?

XXXVII.

UNIVERSITY OF OXFORD, ENG.

Local Examination, Senior Candidates, May, 1881. — *Time allowed, 2 hours.*

No credit will be given for any answer, the full working of which is not shown.

1. How many times is £27 15*s.* $7\frac{3}{4}$*d.* contained in £1356 6*s.* 9*d.*? and how much remains over?

2. Multiply 1 acre 3 roods 7 poles 4 yards by 17.

3. Add together $3\frac{5}{14}$, $5\frac{4}{21}$, $\frac{11}{24}$, and $1\frac{1}{8}$ of $\frac{5}{56}$.

4. In a row of 25 houses, each house has 17 windows, each window 4 panes, and each pane measures 18 inches by 9 inches. What will be the cost of glazing all these windows at 6*d.* per square foot?

5. Multiply 47.625 by 0.128; divide 1.05 by 0.875; and find the value of $\frac{(1.005+0.201)\times(1.005-0.201)}{1.005\times 0.201}$.

6. Reduce £5 17*s.* 7½*d.* to the decimal of £100; and find the value of $0.7\dot{0}\dot{9}$ of 5 tons 3 cwts. 14 pounds.

7. Find the cost of 227 tons 15 cwts. 21 pounds at £12 13*s.* 4*d.* per ton.

8. Extract the square root of 36,180,225 and of 0.000144.

9. Find the simple interest and amount of £225 13*s.* 4*d.* for 2½ years at 4¾ per cent per annum.

10. If the value of 47 pounds 1 ounce of silver be £184 16*s.* ½*d.*, what is the value of 84 pounds 9 ounces?

11. If 27 men mow a field of 90 acres in 7 days, working 8 hours a day, how many men will be required to mow 200 acres in 16 days, if they will work 10 hours a day?

XXXVIII.

UNIVERSITY OF OXFORD, ENG.

Local Examination, Junior Candidates, June, 1882. — *Time allowed*, 2 *hours.*

Every candidate is required to satisfy the examiners in the first part of this paper. The second part is to be attempted by those candidates *only* who offer mathematics as a subject. Attention should be paid to spelling and handwriting. No credit will be given for any answer, the full working of which is not shown.

I.

1. Add together seventeen hundred and seventy, a hundred and seventy thousand and seventy, and seventeen million eight hundred and twenty-nine thousand; and express the result in words.

2. Multiply 302,050 by 702,090; and 4 days 22 hours 33 minutes 49 seconds by 401.

3. Out of a salary of 25 guineas per quarter, how much will be saved in a year, when the expenditure is at the rate of 5*s.* 3*d.* per day?

4. Divide 40,301 acres 0 roods 38 rods 9 yards by 251.

5. Find the number of quarters, bushels, etc., in 2559 pints.

6. Find the value of
$(\frac{7}{55}$ of $\frac{18}{20}) \div (\frac{52}{88}$ of $\frac{21}{26})$; and of $\frac{2}{49}$ cwt. $+ \frac{8}{7}$ pound.

7. Divide 4.00004 by 0.0011; and reduce $0.00\dot{1}2\dot{6}$ to a vulgar fraction.

8. If $6\frac{1}{4}$ tons of coal cost £6 15*s.* 5*d.*, what will be the price of 5 tons 3 cwts.?

II.

9. If 5 men and 9 boys could do a piece of work in 17 days, in how many days would 9 men and 12 boys do it, the work of 2 men being equal to that of 3 boys?

10. Find the simple interest on £2970 16*s.* 8*d.* for 3 years 73 days at £3 2*s.* 6*d.* per cent.

11. A man buys goods which he sells again for £11 18*s.* $\frac{1}{2}d.$, making a profit of 16 per cent; what is the buying price?

12. Pipes A and B can fill a cistern in 3 minutes and 5 minutes, respectively, and C can empty it in $7\frac{1}{2}$ minutes. In what time will the cistern be filled when A, B, and C are all open?

XXXIX.

UNIVERSITY OF OXFORD, ENG.

Local Examination, Senior Candidates, June, 1882. — Time allowed, 2 hours.

No credit will be given for any answer, the full working of which is not shown.

1. Reduce 121 quarters 1 bushel 1 peck to quarts.
2. Into how many allotments, each containing 2 roods 10 perches, can a rectangular field 450 yards long and 121 yards be divided?
3. Reduce to their simplest forms the fractional expressions,
$$\frac{\frac{1}{2}+\frac{1}{3}-\frac{1}{6}}{\frac{1}{2}\text{ of }\frac{1}{3}\text{ of }\frac{1}{6}}, \quad 1-\frac{2}{3+\frac{3}{5-\frac{6}{7}}}.$$
4. Square 109.901 and $0.\dot{2}\dot{3}$.
5. Extract the square root of 35,445.5929.
6. Reduce $\frac{3}{5}\frac{1}{7}$ of £2 2*s.* 9*d.* to the vulgar fraction of £2 2*s.* 7½*d.*; and express in money 0.384375 of £5.
7. Find the weight of a quantity of metal worth £2 2*s.* 9*d.*, having given that 2 tons 8 cwts. 3 quarters 12 pounds is worth £1.
8. How much is gained or lost per cent by buying a number of oranges at 5 for twopence, and selling half of them at two a penny and half at three a penny?
9. Find the simple interest on £7446 12*s.* $2\frac{3}{8}$*d.* for $1\frac{1}{4}$ years at $4\frac{2}{7}$ per cent.
10. During 365 days 6 hours the earth makes 366¼ revolutions about its axis. How long will it take in making 879 revolutions?

11. If 3 men can reap 8 acres in 5 days, working 8 hours a day, in how many days can 8 men, working 12 hours a day, reap 192 acres?

XL.

UNIVERSITY OF OXFORD, ENG.

First Examination of Women, May, 1880.— *Time Allowed*, 2 *hours.*

1. Forty-five telegraph posts, placed at equal distances, extend a mile; how far apart are the posts?

2. How many articles at £3 7*s.* 6*d.* each are worth as much as 324 articles at £1 12*s.* 6*d.* each?

3. Simplify $\frac{2597}{3445} + \frac{1\frac{2}{5}}{6\frac{1}{2}}$.

4. Divide 25.6 by 16, 2.56 by 0.16, and $0.\dot{0}\dot{9}$ by $0.0\dot{4}$.

5. Find the value of

$\frac{4}{17}$ yard + $\frac{42}{2047}$ pole + $\frac{1}{1452}$ rood + $\frac{2}{30855}$ acre;

also of 0.00008544921875 of a ton, and $0.1\dot{8}0\dot{5}$ of a guinea.

6. If 12 men or 15 women do a piece of work in 252 days, in what time can 11 men and 2 women do the same piece of work?

7. Find the cost of papering a room 11 yards 2 feet 4 inches long, 6 yards 2 feet wide, 5 yards 2 feet 6 inches high, with paper 1 yard 4 inches wide, at 3*d.* a yard.

8. Sugar is bought at $1\frac{1}{4}$*d.* a pound, and sold at £18 13*s.* 4*d.* a ton; find the gain or loss per cent.

9. Divide a sovereign between A, B, C, so that A may have fourpence more than B, and B tenpence more than C.

10. A gives a fifth of a cake to B, and then a quarter of the remainder to C, and then a third of what still remains to D. What portions of the cake will A, B, C, D respectively have?

11. Which is the better investment, a four per cent stock at 120, or a five per cent stock at $166\frac{2}{3}$?

XLI.

UNIVERSITY OF OXFORD, ENG.

First Examination of Women, June, 1882. — *Time allowed*, 2 *hours.*

1. How many coins, each weighing 15 dwts. 18 grains, can be made out of 16 pounds 10 ounces 7 dwts. 18 grains of metal?

2. Simplify $\frac{2\frac{2}{3} \text{ of } 5\frac{1}{6}}{13\frac{2}{7}} + \frac{4\frac{1}{4}}{3+\frac{1}{2\frac{1}{2}}} - \frac{5}{12} \div \frac{9}{17}$.

3. Reduce 6 cwts. 2 quarters 24 pounds to the fraction of a ton; and hence find the value at 17*s.* 6*d.* per ton.

4. If turf is sold in pieces 30 inches long and 9 inches wide at £1 0*s.* 10*d.* per 100 pieces, what is the price per square yard?

5. Find the cost of 1095 chests of tea at £7 17*s.* $7\frac{1}{2}d.$ per chest.

6. Reduce 0.00544 to a vulgar fraction in its lowest terms; multiply 0.544 by 0.125; and divide $27.\dot{6}$ by 276 to six places of decimals.

7. Reduce $2\frac{2}{3}$ of $4\frac{1}{2}d.$ to the decimal (i.) of half-a-crown, (ii.) of 7 half-crowns.

8. If 165 bales of goods cost £431 4*s.* $8\frac{1}{4}d.$, what will 264 of the same cost?

9. Find the simple interest on £844 4*s.* 4*d.* for $3\frac{1}{2}$ years at $4\frac{1}{4}$ per cent.

10. The material for a dress cost 7 guineas: if the price of the material chosen had been 25 per cent higher than it is, and half as much again had been used, by how much would the cost have been increased?

11. Divide £3 2*s.* 6*d.* between three persons so that the first shall have 7*s.* 6*d.* more than the second, and the second 5*s.* more than the third.

12. If $\frac{1}{15}$ of the pupils of a school are in the sixth form, $\frac{3}{20}$ in the fifth, $\frac{1}{4}$ in the fourth, and 96 in the lower forms, what is the whole number of pupils in the school?

XLII.

University of Oxford, Eng.

First Examination of Women, June, 1883. — *Time allowed*, 2 *hours.*

1. Divide 436 acres 3 roods 3 yards 4 feet 72 inches by 19.

2. Simplify $1\frac{1}{18}\frac{1}{1}$ of $6\frac{1}{4} - 7\frac{5}{8}$ of $1\frac{8}{17} + \dfrac{2}{5+\dfrac{1}{6+\frac{2}{11}}}$.

3. What fraction of £2 19*s.* $\frac{3}{4}d.$ is £1 12*s.* $9\frac{1}{4}d.$?
   If the larger of these sums is the value of 12 pennyweights of gold, of what weight of gold is the other the value?

4. A person, purchasing a carpet for a room 21 feet long and 15 feet 9 inches wide, chooses a material which is $\frac{3}{4}$ of a yard wide, and the pattern of which is

complete in each yard of length. How much carpet must he buy in order that the pattern may be unbroken, if the strips are to run lengthwise in the room?

5. Find the cost of 11 tons 3 cwts. 3 quarters 16 pounds at £3 12*s.* 11*d.* per cwt.

6. Multiply 25.3125 by 2.56; divide 648 by 0.0256; and from the sum of $2.\dot{6}$ and $3.58\dot{3}$ subtract 5.05.

7. Reduce £5 18*s.* 10½*d.* to the decimal of £25; and find the value of 0.025 of £1 + 0.35 of 17*s.* 6*d.* + 0.2 of 2½*d.*

8. If the food of 11 persons for 13 weeks costs £112 12*s.* 3*d.*, what will it cost to feed 26 persons for 11 weeks 5 days?

9. At what rate per cent per annum will £40 10*s.* be the simple interest on £432 for 2½ years.

10. A grocer buys 6 cwts. of tea for £70, and sells 4½ cwts. at 2*s.* 6*d.* per pound. At what price per pound must he sell the remainder to bring his profit on the whole to exactly 20 per cent?

11. A person, who had 2 sons and 4 daughters, left an estate of 2800 acres to be divided between them so that each son might have twice as much as each daughter. If one of his sons has a family of 4 sons and 2 daughters, and leaves his share to be divided in the same manner, how many acres will each of his daughters inherit?

12. From a cask of wine, worth 2*s.* 3*d.* per gallon, a sixth part is drawn and replaced by wine worth only 1*s.* 3*d.* per gallon. What is now the value per gallon of the wine in the cask?

XLIII.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

Mathematics, First Stage, May, 1880.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. Divide 285,651 by 77, using only short division. Obtain the remainder correctly, and explain briefly how you obtain it. [6.]

2. What interest per cent does a man get for his money by investing in the three per cents at 90?
   How much must he invest to give him an income of £1153 a year. [6.]

3. Add together $\frac{5}{9}$ of a guinea, $\frac{17}{20}$ of a half crown, $1\frac{7}{36}$ shillings, and $\frac{1}{6}$ of a penny, and reduce the whole to a decimal fraction of a pound. [8.]

4. A man owns three bills, of which one could be paid by a certain number of florins, another by twice that number of half crowns, and the third by six times that number of shillings. The bills amount in all to £7 3*s.* 0*d.* What are the several amounts? [12.]

5. Copper weighs 550 pounds, and tin 462 pounds to the cubic foot. What will be the weight of a cubic foot of a mixture of 6 parts copper to 5 parts tin? [12.]

6. A plate of metal is 106.58 inches long, 14.6 inches wide, and 2 inches thick. Supposing it to be melted, and cast into an exact cube, what would be the edge of the cube? [12.]

XLIV.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

Mathematics, First Stage, May, 1881.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. Make out a bill for the following:
   1 cwt. of indigo at 14*s.* 6*d.* per pound.
   1 ton of cloves at 1*s.* 2*d.* per pound.
   5 cwt. 3 quarters 18 pounds spelter at $4\frac{1}{2}$*d.* per pound.
   7 cwt. 1 quarter 14 pounds block tin at £64 per ton.
   Subtract 10 per cent discount for cash. [7.]
2. Divide 0.736 by 2.85, and 2.85 by 0.0736, in each case to four places of decimals, and find the product formed by multiplying the two quotients together. [7.]
3. Find the G.C.M. and L.C.M. of 3024, 4752, and 7488. [8.]
4. A man invests £3600 in 3 per cent stock at 90. He sells out at 80, and lends $\frac{5}{8}$ of his money at 4 per cent, and $\frac{3}{8}$ at 5 per cent. How long must the loan last, so that when he re-invests his money in 3 per cents at 90, his gain on interest (simple) may exactly equal his loss upon principal? [12.]
5. The sides of a rectangle are 16 feet and 10 feet long respectively. Find, to four places of decimals, the length of the diagonal of a square whose area equals that of the rectangle. [12.]
6. Seventy-five per cent of the area of a farm is arable; of the remainder 85 per cent is pasture, and the rest is waste; the area of the waste is 3 acres 0 roods 20 poles. What is the area of the farm? [12.]

XLV.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

Mathematics, First Stage, May, 1882.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. The cost of labor in producing a certain article was £18 19*s.* 11*d.* It was made by five persons, who severally spent 2, 3, $4\frac{1}{2}$, 6, and 8 days upon it. How should the money be divided among them? [6.]

2. Reduce to their lowest terms the fractions

$$\frac{\frac{3}{4} \text{ of } 0.0603}{\frac{5}{4} \text{ of } 0.00594} \text{ and } \frac{1}{39} \text{ of } 4\tfrac{1}{8} \text{ of } \frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\frac{1}{4}+\frac{1}{5}+\frac{1}{6}}.$$ [6.]

3. Arrange $\frac{1}{0.742}$, $\sqrt{1.81}$, and 1.346 in order of magnitude, and find to five places of decimals by how much the sum of the largest and smallest of these numbers differs from twice the other number. [8.]

4. What is discount? How is it commonly calculated? If a sum of £1000 becomes due three months hence, what is its present value as commonly calculated, and what as correctly calculated, interest being reckoned at 5 per cent? [10.]

5. Given that a meter equals 3.2809 feet; find how many square meters there are in 1000 square yards. [10.]

6. A cubic foot of copper weighs 560 pounds. It is rolled into a square bar 40 feet long. An exact cube is cut from the bar. What is its weight to four decimals of a pound? [12.]

XLVI.

SCIENCE SCHOOLS AND CLASSES, ENGLAND.

Mathematics, First Stage, May, 1883.

Not more than three questions are to be answered. The number of marks assigned to each question is given in brackets.

1. What is a decimal fraction? What is a recurring decimal? Express $\frac{19}{37}$ as a recurring decimal, and 0.0173535 ..... as a vulgar fraction. [6.]
2. Show that the square root of 0.37 exceeds the cube root of 0.217 by a difference which very nearly equals $\frac{1}{186}$. [10.]
3. A publisher sells books to a retail dealer at 5*s.* a copy, but allows 25 copies to count as 24; if the retailer sells each of the 25 copies for 6*s.* 9*d.*, what profit per cent does he make? [8.]
4. In building a wall, 22,500 bricks are used at £1 12*s.* a thousand, 135 bushels of lime at 1*s.* 4½*d.* a bushel, 16½ loads of sand at 3*s.* 6*d.* a load; the labor is reckoned at 9*s.* 6*d.* per thousand bricks laid; and 300 coping stones are used at 1*s.* 7½*d.* apiece, including cost of laying. Make out the above in the form of a bill, and find the amount after deducting 7½ per cent for prompt payment. [8.]
5. The capital of a trading company consists of 4000 A shares of £80 each and 2000 B shares of £25 each; in dividing the profits, 5 per cent of the amount of each share is first paid, and then the remainder, if any, is divided equally amongst the shareholders. The profits of the undertaking in one year were £34,853 12*s.* 6½*d.*; how much would be paid to the holder of an A share and how much to the holder of a B share? [10.]

6. An imperial gallon is 277.274 cubic inches; a Winchester bushel, 2150.42 cubic inches; how many Winchester bushels are equal to 100 imperial bushels? [6.]

XLVII.

Civil Service of Great Britain.

Open Competitive Examination for Out-Door Officers of Customs. July, 1876. — *Time Allowed*, $2\frac{1}{2}$ *Hours.*

1. Add together $4\frac{3}{8}$, $2\frac{5}{6}$, $\frac{13}{24}$, and $\frac{5}{36}$.
2. Subtract $3\frac{13}{14}$ from $5\frac{5}{42}$.
3. Multiply together $5\frac{7}{9}$, $\frac{6}{17}$, $\frac{3}{18}$, and $2\frac{5}{6}$.
4. Divide $5\frac{4}{7}$ by $\frac{13}{14}$.

5. Add together 0.00867, 1.92, 0.806, and 143.9576.
6. Subtract 382.7043 from 400.1036.
7. Multiply 381.42 by 0.0065.
8. Divide 1522.038 by 0.372.
9. Express $\frac{3}{7}$ of 4*s.* 1*d.* as the decimal of 5 guineas.

10. Add together $\frac{2}{3}$, $\frac{14}{25}$, $11\frac{4}{15}$, and $\frac{17}{30}$.
11. Subtract $8\frac{4}{7}$ from $9\frac{1}{18}$.
12. Multiply together $\frac{14}{17}$, $3\frac{6}{7}$, $3\frac{7}{9}$, and $\frac{11}{12}$.
13. Divide $4\frac{10}{11}$ by $10\frac{4}{11}$.

14. Add together 0.725 of a bushel and 2.079 of a gallon, and give the answer in pints and the decimal fraction of a pint.
15. Subtract 10.869 of an ounce from 1.203 of a pound Troy.

16. Multiply 905.8 by 87.06.

17. Divide 0.0054837 by 0.0135.

18. Reduce 0.70596 of 3*s.* 11½*d.* to farthings and the decimal of a farthing.

19. Reduce 4 tons 2 cwt. 1 quarter 11 pounds to ounces.

20. If 2¼ pounds of rice cost 7*d.*, how much may be bought for £6 17*s.* 1*d.*?

21. Find (by practice) the cost of 455,436 articles at £2 13*s.* 10½*d.* per dozen.

22. In what time will £1225 amount to £1417 18*s.* 9*d.* at 3 per cent per annum simple interest?

23. In 8,476,321 inches, how many miles, furlongs, poles, etc.

24. If 2½ acres of pasturage can support 5 oxen for 3½ days, how many would be required to support 26 oxen for 17½ days?

25. Find (by practice) the value of 5 quarters 2 bushels 1 peck of wheat at £4 18*s.* a quarter.

26. Find the amount of £4750 in 3 three years at 5 per cent per annum, compound interest, neglecting fractions of a penny.

XLVIII.

Civil Service of Great Britain.

Open Competitive Examination for Men Clerkships in the Lower Division of the Civil Service, Nov., 1876.—*Time allowed*, 3 *hours.*

1. A and B together earn £3 16*s.* in 8 days, A and C together can earn £7 13*s.* in 17 days, and B and C together £12 15*s.* in 30 days. How much can they severally earn alone?

2. Express 32,567,325 in the duodenary scale.
3. A merchant selling goods at a certain price loses 5 per cent; but, if he had sold them for £4 more, he would have gained 3 per cent. What did the goods cost him?
4. Multiply by duodecimals 3 feet 2 inches by 5 feet 7 inches, and the product by 6 feet 8 inches. What does the answer become when expressed in cubic inches and the decimal fraction of a cubic inch?
5. Extract the square root of $109\frac{2}{7}\frac{8}{2}\frac{8}{9}$, and find the side of a cube containing 2,048,383 cubic inches.
6. What is the present worth of £1801 11*s.*, payable $6\frac{1}{4}$ years hence, at 5 per cent per annum?
7. A bill upon Amsterdam is bought at 12 florins per pound sterling; the proceeds purchase at Amsterdam bills upon Hamburg, at $34\frac{1}{4}$ florins for 40 marks; these are forwarded to Paris and sold at 185 francs per 100 marks. What is the rate of exchange between London and Paris?
8. A train is just 27 minutes in passing through the Mont Cenis Tunnel, the length of which is 11,220 meters; find the speed of the train in miles per hour. (One meter equals 39.39 inches.)
9. In Reaumur's thermometer the freezing point is zero, and the boiling point 80°; in Fahrenheit's thermometer the freezing point is 32°, and the boiling point 212°. What will Reaumur's thermometer mark when Fahrenheit's marks 47°, and what will Fahrenheit's mark when Reaumur's marks 93°?
10. A and B rent a pasture for £138 per annum; A puts in 200 sheep and B 160, but at the end of six months they dispose of half their stock, and allow C to put in 120; what should A, B, and C pay severally towards the rent at the year's end?

11. It is noticed that the water in a reservoir 38 feet long and 26 feet wide, which is known to leak, sinks one inch in 12 hours. A pipe discharging 60 gallons per minute will fill the reservoir in 45 hours, allowing for the leakage. Find within an inch the depth of the reservoir. (A cubic foot of water contains 6.25 gallons.)

12. A man invests £26,180 in the 3 per cents at 93½, but after a time sells out half at 92¼, and invests the proceeds in the 4 per cents at 97. Find to a penny the difference in his income.

13. Find the value of 3.6 of $0.9\dot{5}\dot{4}$ of $0.4\dot{2}857\dot{1}$ of 2*s.* 3*d.*

14. A watch gains 1 minute and 15 seconds a day. It is set right at noon on the 12th of November. What will be the true time when it points at noon on the following Christmas day?

15. The first of a line of 10 sentries, standing at equal distances from each other, wishes to send a message of 20 words to the last. The men begin to walk at the same instant, and walk even distances right and left of their posts alternately, and each time they meet pass on 5 words. The transmission of the message occupies 48 minutes, and the men walk at the rate of 3 miles per hour. How far is the first man from the last?

XLIX.

Civil Service of Great Britain.

Competitive Examination for the Excise, Dec., 1876. — *Elementary Arithmetic.* — *Time Allowed, 2½ hours.*

1. In 372,483 ounces, how many tons, cwts., quarters, etc.

2. If cotton is shipped at 4 guineas a cwt., what is the weight of a bale costing £21 9*s.*?

3. Find (by practice) the value of 27 pounds 6 ounces 6 dwts. of gold dust at £3 10*s.* 5*d.* an ounce.

4. Find the simple interest on £6250 for 18 years at $2\frac{1}{2}$ per cent per annum.

5. Add together $5\frac{3}{7}$, $\frac{14}{15}$, $\frac{19}{42}$, and $3\frac{1}{8}$.

6. Subtract $9\frac{3}{13}$ from $10\frac{1}{143}$.

7. Multiply $6\frac{3}{10}$ by $\frac{25}{27}$.

8. Divide $31\frac{7}{9}$ by $1\frac{62}{81}$.

9. Add together
371.87001, 0.0031, 0.00631, and 5786.44321.

10. Subtract 185.939131 from 186.847.

11. Multiply 323.211 by 0.20343.

12. Divide 343.5777 by 0.525 to three places of decimals.

13. What fraction of a sovereign is 0.345 of £1 4*s.*?

14. Reduce 3 quarters 7 bushels 1 gallon to pints.

15. The market price of wheat being £3 4*s* per quarter, what will be the value of 11 bushels and 3 pecks?

16. Find (by practice) the dividend on £3760 15*s.* at 17*s.* 9*d.* in the pound.

17. Find the amount of £4096 in 3 years at $1\frac{1}{4}$ per cent compound interest (neglecting fractions of a penny).

18. Add together $5\frac{11}{18}$, $\frac{7}{8}$, $3\frac{4}{27}$, and $1\frac{1}{16}$.

19. Subtract $\frac{8}{17}$ from $\frac{7}{13}$.

20. Multiply together $5\frac{6}{17}$, $\frac{85}{144}$, $\frac{36}{49}$, and $1\frac{1}{13}$.

21. Divide $\frac{17}{96}$ by $6\frac{3}{8}$.

22. Add together 11.431, 0.00101, 243.734, 400, and 1.3743.

23. Subtract 876.315 from 1000.01.

24. Multiply 7.3406 by 0.00437.

25. Divide 0.003634 by 0.0632.

26. Find the value of 0.0625 of an acre.

27. Reduce 1 mile 7 furlongs 5 perches $2\frac{1}{2}$ yards to inches.

28. If 49 men can empty a reservoir in 65 days, pumping 8 hours a day, how many hours a day must 196 men pump to empty it in 26 days?

29. Find (by practice) the value of 7719 articles at £1 7*s.* 6*d.* per dozen.

30. At what rate per cent will £461 10*s.* amount to £611 9*s.* in 13 years at simple interest?

31. Add together $\frac{4}{5}$, $\frac{7}{18}$, $1\frac{35}{36}$, and $\frac{15}{91}$.

32. Subtract $12\frac{8}{11}$ from $15\frac{2}{33}$.

33. Multiply together $\frac{7}{18}$, $3\frac{1}{12}$, $1\frac{7}{11}$, and $\frac{3}{74}$.

34. Divide $5\frac{2}{7}$ by $\frac{74}{848}$.

35. Add together 1.001 of a cwt. and 0.039 of a quarter, and give the answer in ounces and the decimal fraction of an ounce.

36. Subtract 0.335 of a gallon from 12.51 of a quart, and give the answer in pints and the decimal of a pint.

37. Multiply 0.003631 by 200.001.

38. Divide 28.028 by 4900.

39. Reduce 13*s.* 6*d.* to the decimal of £3.

L.

Civil Service of Great Britain.

Competitive Examination for the Excise, Dec., 1876. — *Higher Arithmetic.* — *Time allowed*, 3 *hours.*

1. An estate is divided among three persons, A, B, C, so that A has $\frac{5}{8}$ of the whole, and B has twice as much as C. It is found that B has 27 acres more than C. How large is the estate?

2. 2 cwts. 1 quarter 3 pounds of an article is bought for 15*s.*, and 17 pounds is sold for 1*s.* 3*d.* What profit is made per cent?

3. What fraction of 300 yards is 1 furlong 2 poles 6 yards 2 feet? Express the answer as a decimal.

   Express as a fraction of an acre the ground taken up by a path 3 feet broad round a house, the front of which is 57 feet, and side 37 feet long.

4. Extract the square root of $30{,}789\frac{68}{289}$, and the cube root of 2,326,203.125.

5. How many ounces of silver are there in a piece of plate costing £59 10*s.*, the price of silver being 0.255 of £1 per ounce, and the cost of manufacture $\frac{1}{6}$ the value of the silver used?

6. Explain what is meant by the L.C.M. of two or more numbers?

   Find the L.C.M. of 3696, 286, 19,656.

7. Find the value of $1.7\dot{2}$ of $0.\dot{2}7\dot{6}$ of 15.

8. How much must a man invest in $3\frac{1}{2}$ per cents at 91 in order to receive £590 per annum, after paying 4*d.* in the pound income tax?

9. The difference between the discount and interest on a debt due a year and a quarter hence, at 4 per cent, is 5*s*. What is the debt?

10. A tradesman's prices are 12 per cent above cost price. If he allows £1 6*s*. 3*d*. discount on a bill of £21, what profit does he make per cent?

11. A man rents a house from the first of January at £142 per annum, payable half-yearly. He sublets it for £160 per annum, payable quarterly. Allowing simple interest at 4 per cent, what will he make by the transaction in 3 years?

12. A cistern containing 600 gallons measures externally 7 feet in length, 2 feet 11 inches in breadth, and 5 feet 6 inches in height. The sides being $1\frac{1}{2}$ inches thick, what is the thickness of the bottom? (A cube foot of water contains $6\frac{1}{4}$ gallons.)

13. The map of a country is drawn on the scale of $\frac{1}{10}$ of an inch to a mile. What area on the map will represent a lake 4000 acres in extent?

14. A fast train leaves a place A for another place B at the same moment that a slow train leaves B for A. The fast train takes 2 hours on the journey, and, if the slow train kept its time, they would meet at a distance from B equal to $\frac{3}{5}$ the whole distance from A to B. Instead of this, the place where they meet is at a distance from B equal to $\frac{1}{4}$ the distance from A to B. How much behind time will the slow train be when it arrives at A?

15. A round column stands on a cubic pedestal of the same material, whose edge is 6 feet. The column is hollow, the external and internal diameters measuring 5 feet and 4 feet, respectively. If the weight of the column be the same as that of the pedestal, what is its height?

LI.

Civil Service of Great Britain.

Open Competitive Examination for Clerkships of the Superior Class in the India Office, 1879. — *Elementary Arithmetic.* — *Time allowed*, 2½ *hours.*

1. Reduce 6 tons 3 cwts. 2 quarters 14 pounds to ounces.
2. What must be given for a piece of silver weighing 73 pounds 5 ounces 15 pennyweights, at the rate of 5*s.* 9*d.* an ounce?
3. Find (by practice) the value of 1 ton 3 cwts. 1 quarter 14 pounds at £3 10*s.* per ton.
4. Find the simple interest on £840 15*s.* for $6\frac{3}{4}$ years at 3 per cent per annum (neglecting fractions of a penny).
5. Add together $\frac{17}{25}$, $4\frac{1}{8}$, $\frac{13}{75}$, and $1\frac{2}{15}$.
6. Subtract $7\frac{8}{11}$ from $12\frac{1}{48}$.
7. Multiply $8\frac{8}{11}$ by $2\frac{3}{26}$.
8. Divide $3\frac{8}{17}$ by $2\frac{16}{51}$.
9. Add together 3106.8157, 0.0624, 0.00441, and 43.2875.
10. Subtract 84.937658 from 100.3062431.
11. Multiply 947.36 by 0.00423.
12. Divide 950.562 by 19.56 to three places of decimals.
13. Reduce 0.0016395 of a pound Troy to grains and the decimal of a grain.
14. Reduce 8,868,097 square feet to acres, roods, perches, and yards.

15. If 10 men can build a wall 65 feet long and 5 feet high in $3\frac{1}{4}$ days, in how many days will 6 men build a wall 80 feet long and 4 feet high?

16. Find (by practice) the dividend on £8236 10*s.* at 4*s.* 7*d.* in the pound.

17. Find the amount of £7205 in 3 years at 6 per cent compound interest (neglecting fractions of a penny).

18. Add together $\frac{1}{6}$, $\frac{1}{15}$, $\frac{1}{18}$, and $4\frac{1}{6}$.

19. Subtract $1\frac{1}{9}$ from $3\frac{1}{18}$.

20. Multiply together $\frac{2}{3}$, $\frac{5}{7}$, $1\frac{3}{4}$, and $1\frac{1}{8}$.

21. Divide $10\frac{1}{8}$ by $1\frac{11}{16}$.

22. Add together 16.41215, 9.376, 0.00403, 177.42, and 27.03067.

23. Subtract 17.2398 from 27.06.

24. Multiply 46.2375 by 0.00743.

25. Divide 92.3784 by 0.623 to four places of decimals.

26. Find the value of 1.025 of £1 13*s.* 4*d.*

27. In 406,395 pints how many bushels, pecks, gallons, etc.?

28. If the 6*d.* loaf weigh 4 pounds, when wheat is at 36*s.* a quarter, what should the 1*d.* loaf weigh when wheat is at 48*s.* a quarter?

29. Find (by practice) the value of 17 *ounces* 10 pennyweights 12 grains at £1 13*s.* 4*d.* an ounce.

30. At what rate per cent will £2100 amount to £5250 in 3 years?

31. Add together $5\frac{3}{7}$, $\frac{11}{4}$, $\frac{8}{9}$, and $\frac{13}{56}$.

32. Subtract $8\frac{7}{9}$ from $12\frac{3}{14}$.

33. Multiply together $10\frac{1}{2}$, $2\frac{5}{6}$, $\frac{4}{7}$, and $3\frac{5}{20}$.

34. Divide $10\frac{4}{5}$ by 13.

35. Add together 3.062 of a day and 1.5347 of an hour, and give the answer in minutes and the decimal fraction of a minute?

36. Subtract 5.017 of a furlong from 1.358 of a mile, and give the answer in yards and the decimal fraction of a yard?

37. Multiply 34.0069 by 0.005006.

38. Divide 0.038452 by 0.1005 to three places of decimals.

39. Reduce £1.00065 to farthings and the decimal of a farthing.

LII.

Civil Service of Great Britain.

Open Competitive Examination for Clerkships of the Superior Class in the India Office, 1879. — *Higher Arithmetic.* — *Time allowed*, 3 *hours.*

1. If 26 sheep be worth 5 oxen, 2 oxen be equal in value to 3 horses, and 7 horses can be purchased for 91 guineas, find the value of 1 sheep.

2. Simplify the following, and express the results as decimals:

   (i.) $(2 \div 1\frac{1}{2}) \times (3 \div 2\frac{2}{3}) \times (4 \div 3\frac{3}{4})$.

   (ii.) $\dfrac{2\frac{1}{5} \text{ of } 3}{3\frac{2}{3} \text{ of } 2} - \dfrac{1\frac{1}{2} \text{ of } 2\frac{2}{3}}{3\frac{3}{4} \text{ of } 4\frac{4}{5}} + \dfrac{1\frac{4}{7}}{2\frac{1}{8}} - \dfrac{2\frac{2}{3} - 1\frac{1}{2}}{2\frac{2}{3} + 1\frac{1}{2}}$.

   (iii.) $0.1\dot{6} \div 0.00\dot{2}\dot{7}$.

3. Divide 987,654,321 by 3509, and 0.00321 by 0.000011. Find the value of $2.01\dot{3}\dot{6}$ of £2 1*s.* 3*d.*

4. Explain what is meant by the G.C.M. and the L.C.M. of several arithmetical quantities.

Find the G.C.M. of 5049, 4301, 3553.

The driving-wheel of a locomotive engine is 27½ feet in circumference, and the fore-wheel 16 feet. Two particular spokes, one in each wheel, are observed pointing vertically upwards. How far will the engine travel before the same two spokes are again simultaneously in the same direction, and how often will this happen in 9 miles?

5. What is the present worth of £1866 16*s.*, payable 2 years hence at 3 per cent per annum?

6. The area of a rectangular piece of ground is 87 acres 1 rood 26 perches. What is its length, its breadth being 462.5 links?

7. A block of granite is 17.7 feet broad, 9.4 thick; what length must be cut off so as to contain 554.6 cubic feet?

8. Find the square root of 1,874,161. Extract to 4 places of decimals the cube root of 0.002.

What must be the side of a cubical cistern which is to contain 1000 gallons of water, if a gallon contains 277.164 cubic inches?

9. A grocer mixes 2 kinds of sugar at 4*d.* and 6½*d.* per pound, taking 3 pounds of the first to 2 of the second. At what price per pound must he sell the mixture to gain a profit of 20 per cent?

10. Divide £144 10*s.* among 3 persons in the proportions of 0.3, 0.33, and $0.\dot{3}$.

11. A merchant invests half of a sum of money in the 3 per cents at 92, and the other half in the 3½ per cents at 98. Which is the better investment? If he receives £44 as income, what is the amount of the sum?

12. A man insures to the value of £445 6*s.* 8*d.* on goods, the rate of insurance being $4\frac{3}{8}$ per cent. Losing the goods by an accident, he finds that he recovers both their value and the premium paid. What was their actual value?

13. Find the cost, at 4 guineas per 100 square feet, of laying in stone the ground floor of a house which measures 21 feet by 18 feet, allowing for each of 4 fire-places a space 3 feet by 2 feet 6 inches, and for the well-hole of the staircase a space of 9 feet square.

14. A cistern can be filled by 1 tap in 3 hours, by another in 3 hours and 40 minutes, and emptied by a third in 2 hours and 20 minutes. If they are all opened together, in what time will the cistern be filled?

15. Reduce to a decimal, accurate to 7 places,

$$\frac{1}{1\times 3}+\frac{1}{1\times 3\times 5}+\frac{1}{1\times 3\times 5\times 7}+\text{etc.}$$

LIII.

Civil Service of Great Britain.

Open Competitive Examination for Admission to the Royal Indian Engineering College, July, 1879. — *Time Allowed*, 3 *hours*.

1. Add together $5\frac{2}{9}$, $3\frac{7}{18}$, $2\frac{7}{36}$, $\frac{11}{12}$, and $2\frac{1}{8}$.
2. Subtract $3\frac{5}{7}$ from $4\frac{3}{8}$.
3. Multiply together $1\frac{4}{11}$, $2\frac{13}{15}$, $2\frac{25}{48}$, $1\frac{3}{17}$, and $\frac{51}{55}$.
4. Divide $10\frac{18}{23}$ by $1\frac{9}{115}$.

5. Add together 12.613, 0.00175, 257.8425, and 0.001345.
6. Subtract 17.9159 from 230.775.

7. Multiply 35.6 by 0.01094.
8. Divide 10.8528 by 1.02.
9. Express 2 cwt. 3 quarters 3 pounds 8 ounces as the decimal of a ton.

10. Add together $\frac{11}{17}$, $\frac{10}{221}$, and $2\frac{7}{13}$.
11. Subtract $6\frac{5}{11}$ from $7\frac{2}{13}$.
12. Multiply together $3\frac{5}{6}$, $\frac{17}{35}$, $2\frac{11}{12}$, $\frac{50}{51}$, and $\frac{14}{15}$.
13. Divide $3\frac{14}{15}$ by $7\frac{24}{25}$.

14. Add together 5.75 of a bushel and 3.625 of a quart, and give the answer in gallons and the decimal of a gallon.
15. Subtract 7.3125 of a furlong from 1.03125 of a mile; give the answer in yards and the decimal of a yard.
16. Multiply 7.50605 by 1.0907.
17. Divide 145.0052 by 0.00785.
18. Reduce 3.031 pounds to grains and the decimal of a grain.

19. How many days of 8 hours each will it take to dig a ditch 2 yards wide, enclosing a square plot containing 360,000 square feet, at the rate of $2\frac{1}{2}$ yards in $3\frac{3}{4}$ hours?
20. Multiply by duodecimals 3 feet 2 inches 7 parts by 5 feet 1 inch 3 parts, and the product by 2 feet 7 inches. Give the answer in cubic feet, cubic inches, and the fraction of a cubic inch.
21. The walls of a room 21 feet long, 15 feet 9 inches wide, 11 feet 8 inches high, are painted at an expense of £17 17*s*. $3\frac{1}{2}$*d*. Find the additional expense of painting the ceiling at the same rate.

22. A ditch has to be made 360 feet long, 10 feet wide at the top and 3 feet wide at the bottom, the angle of the slope of each side being 45°. Find the number of cubic yards to be excavated.

23. A circular pond has an area of $346\frac{1}{2}$ square yards. Find to the nearest penny the cost of fencing it round at 4*s.* 6*d.* per lineal yard.

24. A cubical block contains 1 cubic yard, 2 cubic feet, 541 cubic inches. Find the cost of covering the entire surface with lead at 1*s.* 6*d.* per square foot.

25. A hemispherical punch-bowl is 5 feet 6 inches round the brim. Supposing it to be half full, how many persons may be helped from it in hemispherical glasses $1\frac{3}{4}$ inches in diameter?

LIV.

Civil Service of Great Britain.

Open Competitive Examination for Admission to the Royal Indian Engineering College, July, 1880. — *Time Allowed*, 3 *hours.*

1. Add together $4\frac{1}{10}$, $7\frac{9}{35}$, $1\frac{1}{7}$, $\frac{13}{14}$, and $1\frac{17}{21}$.
2. Subtract $2\frac{9}{10}$ from $3\frac{3}{13}$.
3. Multiply together $1\frac{5}{11}$, $17\frac{7}{8}$, $1\frac{15}{47}$, $1\frac{1}{93}$, and $2\frac{5}{39}$.
4. Divide $7\frac{5}{29}$ by $3\frac{141}{145}$.
5. Add together 17.429, 0.0173, 1156.8, and 0.0001723.
6. Subtract 60.25738 from 356.17.
7. Multiply 7.18 by 0.0919.
8. Divide 331.8553 by 55.3.
9. Express 1 peck 1 gallon 3 quarts as the decimal of a quarter.

10. Add together $\frac{14}{15}$, $\frac{1}{17}$, and $1\frac{104}{105}$.

11. Subtract $19\frac{1}{19}$ from $20\frac{1}{20}$.

12. Multiply together $2\frac{1}{8}$, $1\frac{1}{84}$, $1\frac{4}{17}$, and $\frac{8}{55}$.

13. Divide $7\frac{11}{12}$ by $1\frac{19}{24}$.

14. Add together 2.25 of a cwt. and 5.76 of an ounce, and give the answer in quarters and the decimal of a quarter.

15. Subtract 18.75 dwts. from 2.12875 pounds, and give the answer in grains and the decimal of a grain.

16. Multiply 42.317 by 10.075.

17. Divide 48 by 0.144.

18. Reduce 19.062 furlongs to inches and the decimal of an inch.

19. A steel plate is 11 feet 6 inches 5′ long, 3 feet 2 inches 8′ wide, and 1 inch 3′ thick. Find, by duodecimals, the number of cubic feet, cubic inches, etc., it contains.

20. Two circular courts measure 40 and 50 feet in diameter. The paving of the former costs £74 16*s*. 8*d*. Find the cost of paving the latter at the same rate.

21. A rectangular room has its length, breadth, and height as 7, 6, 5, respectively. Its walls were decorated at a cost of 2*s*. 6*d*. per square yard, and its ceiling finished at the same rate. The bill for the whole was £86. What will be the expense of covering the floor with carpet at 7*s*. per square yard?

22. Find the cost of constructing a hemispherical dome of stone, the internal diameter of which is 45 feet, and uniform thickness 18 inches, at 4*s*. 1*d*. per cubic foot of masonry.

23. The diameters of a conical frustum of marble are $17\frac{1}{2}$ and $10\frac{1}{2}$ inches, and the height 24 feet. Find its volume.

24. A and B receive 1600 cabbages to plant, but of these 10 prove worthless. A plants 5 while B plants 4, and the rows are equal. After some hours they have not sufficient between them to complete another row, A having 45 to spare and B 6. A then finds he has planted three rows more than B. How many did each plant, and how many cabbages in a row?

25. A fast train, travelling at the rate of 36 miles per hour, leaves Dover for London, 79 miles distant, at 8 A.M., and is shortly after followed by a slow train whose speed is 24 miles per hour. The former train meets at 8.45 the express from London, which covers 48 miles in the hour; and the slower train from Dover meets the express $12\frac{1}{2}$ minutes later. Find at what time the express leaves London and the slow train Dover, supposing both trains to travel uniformly between Dover and London.

LV.

Civil Service of Great Britain.

Competitive Examination of Candidates nominated for Appointments in the India Forest Department, Jan., 1880. — *Elementary Arithmetic.* — *Time allowed*, $2\frac{1}{2}$ *hours.*

1. Reduce 4 tons 1 cwt. 11 pounds to ounces.

2. If 1 pound 2 ounces 5 pennyweights of gold cost £69 9*s.* $4\frac{1}{2}$*d.*, what is the price per ounce?

3. Find (by practice) the value of 2 cwts. 2 quarters 21 pounds at £4 per ton.

4. Find the simple interest on £3650 for 8 years at $3\frac{3}{4}$ per cent per annum.

5. Add together $\frac{2}{3}$, $\frac{5}{6}$, $\frac{1}{4}$, and $\frac{7}{12}$.

6. Subtract $2\frac{12}{17}$ from $4\frac{3}{20}$.

7. Multiply $5\frac{1}{3}$ by $1\frac{1}{8}$.

8. Divide $5\frac{6}{11}$ by $2\frac{1}{2}$.

9. Add together 0.20765, 0.00631, 6758.13247, and 5.973.

10. Subtract 39.984 from 400.29.

11. Multiply 62.093 by 2.568.

12. Divide 14.9455 by 35.5.

13. Reduce 0.325 of 10 cwts. to pounds.

14. Reduce 2 pounds 3 ounces 4 pennyweights to grains Troy.

15. If 3 acres 2 roods of land cost £375, what will be the value of 4 acres 2 roods 29 perches?

16. Find (by practice) the value of 32,679 articles at £1 11*s.* 6*d.* per dozen?

17. Find the amount of £2930 in 3 years at 2 per cent per annum compound interest.

18. Add together $2\frac{5}{6}$, $\frac{11}{14}$, $3\frac{1}{3}$, and $\frac{5}{7}$.

19. Subtract $15\frac{15}{16}$ from $20\frac{8}{25}$.

20. Multiply together $2\frac{3}{4}$, $4\frac{4}{5}$, $5\frac{5}{6}$, and $\frac{1}{7}$.

21. Divide $\frac{16}{27}$ by $2\frac{1}{8}$.

22. Add together 0.61692, 243.734, 400, 67.45213, and 2.683.
23. Subtract 284.7654 from 321.07659.
24. Multiply 2.8456 by 0.00325.
25. Divide 85.5 by 0.00684.
26. Express 3*s.* 9*d.* as the decimal of a pound.
27. In 1,320,765 square inches, how many acres, roods, perches, etc.?
28. If the second class railway fare is $\frac{2}{5}$ that of the first, and the third class $\frac{1}{2}$ that of the second, and a first class passenger can travel 125 miles for £1 11*s.* 3*d.*, how far can a third class passenger travel for 8*s.* 4*d.*?
29. Find (by practice) the dividend £269 17*s.* 6*d.* at 13*s.* 10*d.* in the pound.
30. In what time will £1050 amount to £1548 1*s.* 10½*d.* at 5¾ per cent per annum simple interest?

31. Add together $5\frac{11}{18}$, $2\frac{3}{4}$, $\frac{9}{26}$, and $\frac{15}{52}$.
32. Subtract $9\frac{9}{19}$ from $19\frac{4}{57}$.
33. Multiply together $\frac{12}{35}$, $2\frac{5}{6}$, $\frac{8}{106}$, and $1\frac{7}{46}$.
34. Divide $4\frac{4}{5}$ by $6\frac{2}{3}$.

35. Add together 0.32 of a pound and 0.45 of a shilling, and give the answer in pence and the decimal fraction of a penny.
36. Subtract 0.428 of a gallon from 3 quarts 1.25 pints, and give the answer in pints and the decimal of a pint.
37. Multiply 0.07864 by 0.000973.
38. Divide 16.8951 by 28,300.
39. Express 3 furlongs 2 poles as the decimal of $2\frac{1}{2}$ miles.

LVI.

Civil Service of Great Britain.

Competitive Examination of Candidates Nominated for Appointments in the India Forest Department, Jan., 1880.—*Higher Arithmetic.*—*Time Allowed, 2½ hours.*

1. Find the square root of 64.55961801, and of $70\frac{21}{289}$.
2. Resolve 2520, 2772, and 30,888 into their prime factors, and thence deduce their L.C.M.
3. Find the value of $\left(4\frac{3}{8} \div \frac{9\frac{1}{10} \div \frac{2}{11}}{2\frac{6}{7} \div \frac{1}{42}}\right) \times 0.3\dot{6} \times 0.2\dot{3}\dot{6}$ of 11 shillings.
4. Divide £3293 6*s.* 6*d.* among 5 persons in the proportion of the fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{7}$.
5. Multiply (by duodecimals) 4 feet 3 inches 7 parts by 2 feet 6 inches 3 parts, and the product by 8 feet 9 inches. What does the answer become when expressed in cubic feet, cubic inches, and the fraction of a cubic inch?
6. Find the length of the edge of a cube containing 12 cubic feet 1216 cubic inches, and the cost of covering this cube with copper at $10\frac{1}{2}$*d.* per superficial foot.
7. A plot of land, containing 4 acres 3 roods 20 perches, is valued in 1879 at £1681 17*s.* 6*d.*, being 15 per cent more than it was estimated to be worth in 1878. What was the estimated value per acre in 1878.
8. A man has £5000 of stock in the 3 per cents. He sells out when they are at 98, and invests £2000 in India stock at 104, paying 4 per cent, and the remainder in railway shares at $87\frac{1}{2}$, paying 5 per cent. Find to a penny the alteration in his income.

9. A cistern, measuring inside 4 feet 9 inches long, 3 feet 6 inches wide, and 3 feet deep, is filled with water. Find approximately the number of gallons it contains, and the weight of water on a square inch of the bottom. (A cubic foot of water is equal to 6.25 gallons, and weighs 62.321 pounds.)

10. A sovereign of standard gold weighs 5.136 dwts., and a shilling of standard silver weighs $\frac{1}{66}$ of a pound Troy. What weight of standard silver is equivalent in value to 5 ounces of standard gold?

11. A water-tank can be filled by one tap in 3 hours, and by another in 2 hours. It can be emptied by a third tap in 1 hour 24 minutes. The tank being empty, all three taps are opened at once. Required the time of filling it under these circumstances.

12. A starts to walk from London to Croydon, a distance of 10 miles, at the same moment that B leaves Croydon for London. A walks at the rate of 3 miles an hour, and B at the rate of $2\frac{3}{4}$ miles an hour; but, soon after they started, A met with an accident which caused him to lose 15 minutes on the road. At what distance from London will they meet?

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